5622

MICROCOMPUTER

SMC-70

SONY

SERVICE MANUAL

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SECTION 1
OPERATION

1-1 FEATURES

The Sony SMC-70 personal computer is a very high performance personal microcomputer based on the Z-80 CPU. In its basic configuration, (the SMC-70) a full 64K bytes of RAM are available to the user at all times, in addition 32KB graphic RAM and 2KB character RAM used for the screen memory, 2KB programmable character generator and 2KB attribute RAM and of course the system ROM which contains the system monitor, Sony BASIC and character font.

The video capabilities of the Sony SMC-70 personal computer are outstanding, offering four levels of graphics definition with full control over the colors displayed and fully user definable characters. The capabilities of the Sony SMC-70 can be greatly extended by a full range of sophisticated options, including such advanced items as the SMI-7080 Battery Back-up Unit, the SMI-7011 Microfloppy Disk Drive Unit and the SMI-7050 Cache Disk Unit. These options are described in detail elsewhere in this manual.

Z-80A CPU

The SMC-70, incorporating a Z-80A central processing unit (CPU), is an 8-bit general-purpose computer. To facilitate programming, the Z-80A has 158 basic instructions including block transfer and block search, bit operation, and so forth. Using the features of the Z-80A, the SMC-70 allocates the video RAM to the I/O area, allowing effective use of the main memory.

Hardware configuration that can be programmed

The entire 64K byte main memory consists of RAM and is open to the user. The video RAM is mapped in the I/O area. The System Monitor and Sony BASIC interpreter are written in shadow ROM format; that is, the mass memory can be fully utilized when a new system software is used. (In the shadow ROM format, programs written in ROM are moved into the RAM area when required). The I/O units, such as the keyboard encoder and CRT controller, can be programmed flexibly so that they match the application program. Many peripheral devices are provided for system expansion to meet various applications such as hobbies, business, and scientific uses.

Utilizing with various software

The SMC-70 can select the program to be started at power on. One program which can be selected is the System Monitor; it can be used continuously or can be switched easily to Sony BASIC. The System Monitor can also be switched to another system program on a disk or ROM pack.

The other program which can be selected is the program on a disk. A general-purpose Disk Operating System CP/M is available optionally as the standard system of the SMC-70. The CP/M can be started as soon as the power is switched on. The CP/M allows the use of various software developed for CP/M, such as high-level languages like FORTRAN or COBOL, assembler, and commercially available software packages.

Furthermore, the autostart ROM pack developed for the SMC-70 can be started with the SMC-70's initial power on. Thus, the SMC-70 can utilize many kinds of software.

System monitor

The System Monitor, located in the SMC-70, starts the computer, receives input from the keyboard, transfers the input to the CPU, displays the cursor and characters on the display screen, and so forth. In addition to these basic monitor functions, the following functions are also provided for effective program development and debugging:

- Display of the main memory contents
- Writing into the main memory
- Display and direct writing of the CPU register contents
- Conversion between machine codes and assembler-in-natural-notation (ANN)
- Start of Sony BASIC, DOS, and ROM pack
- Input/output control
- Internal operation check of the SMC-70

SONY BASIC

Those who have never operated a computer can master Sony BASIC in a relatively short period of time, and can soon write a variety of high-level programs using the following basic functions designed for a wide range of applications:

- A DRAW command allows drawing of any kind of graphic.
- A PLAY command permits enjoyment of musical performances.
- A Special command is provided so that machine-language subroutines can be generated easily. Switching between the System Monitor and Sony BASIC is at your disposal.
- The Sony BASIC program and machine-language subroutines can be saved or loaded simultaneously.
- Real numbers are indicated with 14 significant digits (floating-point indication). Precise calculation is possible.
- A LINK command is provided to enable linkage with the machine-language program on the ROM pack or cassette tape; commands can be extended for peripheral equipment.

To save programs written in Sony BASIC, a cassette tape recorder must be used.

High-resolution graphic display

Using the graphic commands of the Sony BASIC, a graphic display can be made with 320x200 dots. Since the graphic and character display screens are controlled separately, characters can be displayed over graphics, the screen can be changed instantly from characters to graphics, and so forth.

In addition, 16 colors can be used so that various screen display techniques can be utilized.

If you control the hardware with a program, one of four graphic display modes can be selected.

There are four display surfaces in the 160x100 dot mode. Therefore, if your pictures, which move continuously, are displayed sequentially, an animated cartoon can be generated.

1-2 SPECIFICATIONS

CPU

Processor used Z-80A

Clock frequency 4.028 MHz

Wait 10% or less during graphic RAM accessing (none in other cases)

Interrupt Non-maskable interrupt
Z-80A mode 1 maskable interrupt

Resetting Automatic at power on/Manual
(Memory contents are saved at manual resetting.)

MEMORY

Main memory 64K bytes (64K bits/chip dynamic RAM)

Video RAM Graphic: 32K bytes (16K bits/chip dynamic RAM)
Character: 2K bytes
Attributes: 2K bytes
PCG: 2K bytes
} (16K bits/chip static RAM)

ROM 32K byte, shadow ROM format
System Monitor: 9K bytes
Sony BASIC: 22K bytes
Character font: 1K bytes

CRT DISPLAY

CRT controller HD46505S-1

Display screen Superimposition of character and graphic display screens, Border area

Character display 8 x 8 dot matrix/character
80 or 40 characters x 25 lines
8 colors

Graphic display Mode 1: 160 x 100 dots, 16 colors, 4 pages
Mode 2: 320 x 200 dots, 16 colors
Mode 3: 640 x 200 dots, 4 colors
Mode 4: 640 x 400 dots, black and white

Border area 16-color display

Output interface Color: RGB analog signal, 0-0.7 V, TTL level separate sync signal, composite sync signal 1 Vp-p, 75 ohms ±20%
Monochrome: composite video signal 1 Vp-p, TTL level separate sync signal, sync negative, 75 ohms ± 20%.
Horizontal sync signal frequency: 15.73 kHz ± 0.5%
Vertical sync signal frequency: 60 Hz

I/O INTERFACE

Keyboard Keyboard encoder with microprocessor
Total number of keys: 72
Display control keys: 8
Programmable function keys: 5
Programmable help key: 1
Input for numeric key pad: 13-pin connector

Audio cassette interface 8-pin DIN jack
Baud rate: 1200 b/s
Remote control function provided

Printer interface 25-pin connector
TTL level
Standard 8-bit parallel transfer

RS-232C interface 25-pin connector
TTL level
Baud rate: 75–19,200 b/s (selectable)

Speaker 8 ohms, 3.6 cm dia
Output level: selectable between 3 outputs

Earphone Minijack
Output level: selectable between 3 outputs

RGB video output 25-pin connector
0–0.7 V, 75 ohms

Monochrome video output 8-pin DIN jack
1 Vp-p, 75 ohms, sync negative

Light pen interface 5-pin DIN jack

Slots for expansion 50-pin connector
Inside: 2 slots
Outside: 3 slots
Maximum dc current drain (total of 5 slots)
+ 5 V . . . 2.4 A
+12 V . . . 1.2 A
–12 V . . . 70 mA

Connector for expansion unit 50-pin connector

GENERAL

Power requirement 120 V ac ± 10%, 50/60 Hz

Power consumption 28 W (for main unit only)
65 W (max.)

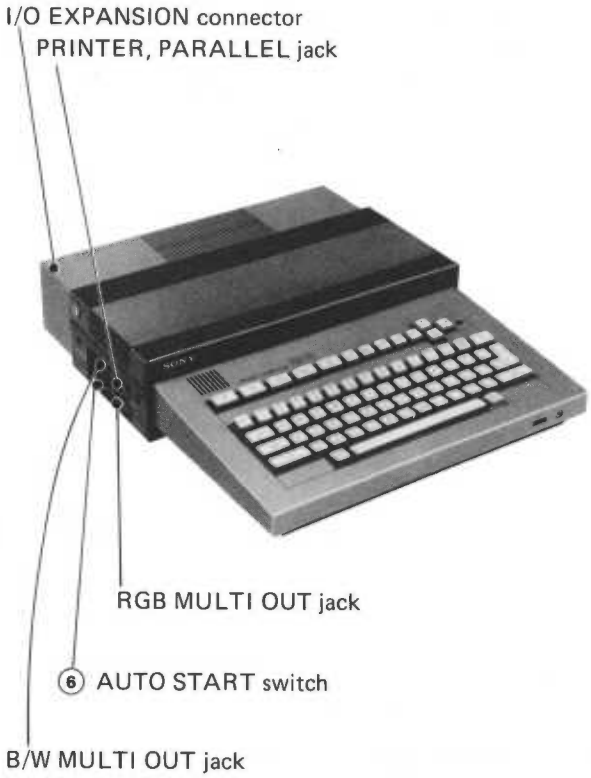
Operating conditions Temperature: 5°C to 35°C (41°F to 95°F)
Humidity: 20 to 80%

Storage temperature –15°C to +60°C (5°F to 140°F)

Dimensions 368 x 90 x 444 mm (w/h/d)
(14 1/2 x 3 5/8 x 17 1/2 inches)
main unit only, including projecting parts and controls

Weight 4.8 kg (10 lb 9 oz)

1-3 PARTS IDENTIFICATION



① **POWER switch**
Press the switch on the side with the white dot to turn on the computer.

② **POWER indicator**
This green indicator lights up when the computer's power is on.

③ **RESET button**
Press this button with the erase-end of a pencil or a similar object when the program runs away, or to set the SMC-70 to the initial state. The computer will return to the same status as when you first turn on it. However, the memory contents will be retained.

④ **Keyboard**
The keyboard is used to load a program or data into the computer.

⑤ **SOUND LEVEL selector**
Select the volume of the sound emitted from the speaker or an earphone.

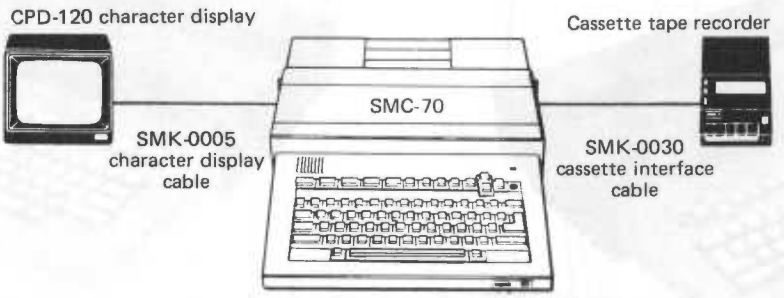
⑥ **AUTO START switch**
This switch selects the program which will start operating when the power is turned on.

ROM: Starts the program on the ROM, pack connected to the port 70H.
DISK: Starts the program on the disk, such as the CP/M.
OFF: No program starts automatically. The System Monitor will wait for your command.

The programs on the disk and the ROM pack must be written in a specified format. Refer to the manual of your program to determine whether it will start automatically or not.

1-4. MINIMUM SYSTEM CONFIGURATION

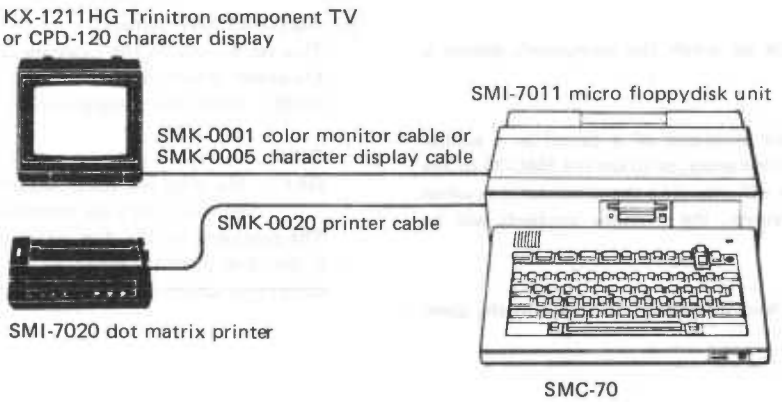
System using an audio cassette tape as an external memory
An audio cassette tape is handy as an external memory for a microcomputer. However, it takes a relatively long time for program saving and loading, and there are some restrictions when generating a data file.



This system is suitable for home use.
For color display, use a KX-1211HG Trinitron component TV.

System using a floppydisk as an external memory
A floppydisk assures high-speed data input/output and random access to files: however, the floppydisk must be handled more carefully. With the SMC-70, you can use $3^1/_2$ -inch micro floppydisks or 8-inch floppydisk (single side/single density).

A) System using a micro floppydisk
The micro floppydisk is a $3^1/_2$ -inch disk enclosed in a hard case. The memory capacity of this disk is approximately 280K bytes. The Sony SMI-7011 micro floppydisk unit, incorporating a disk controller, can be mounted directly on the SMC-70 frame, minimizing required system space. Since the floppydisk is enclosed in a hard case, it can be handled relatively easily and can be used in the same manner as a cassette tape.



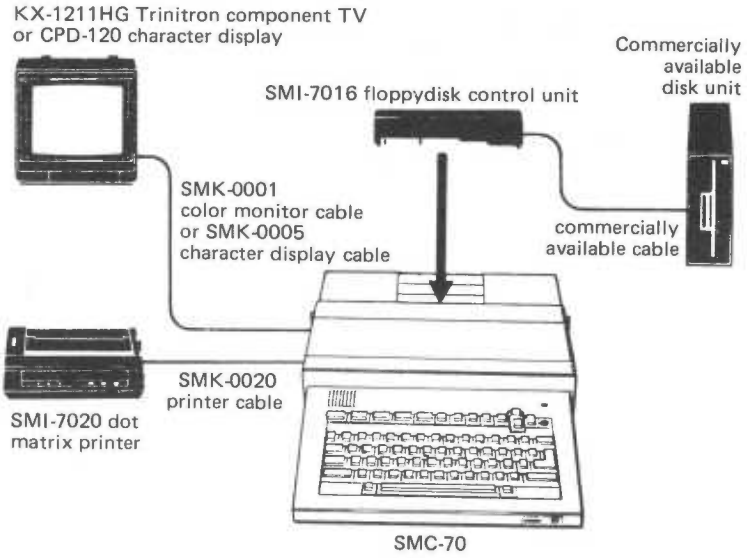
If the memory capacity of this system is insufficient, an SMI-7012 dual micro floppydisk unit or SMI-7013 external micro floppydisk unit can be used to extend the system up to four disks.

SMI-7012 dual micro floppydisk unit (This unit can be attached directly onto the SMC-70 main frame)

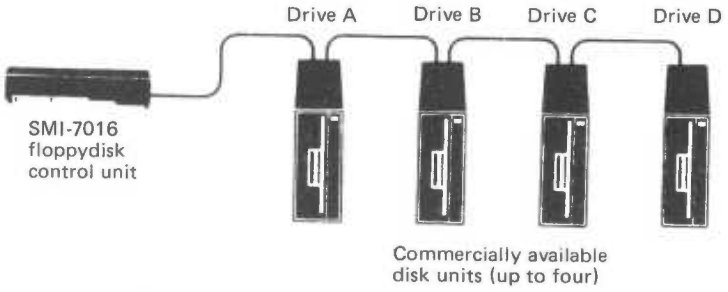
SMI-7013 external micro floppydisk unit (equipped with its own power supply)

SMI-7014 micro floppydisk drive unit (This unit is to be mounted on the SMI-7011 or SMI-7013)

B) System using a standard floppydisk
This system may be required to operate commercially available software packages which are on standard 8-inch floppydisk, or to extend the system's external memory capacity to its maximum.



Up to four drive units can be connected to the SMI-7016 floppydisk control unit.

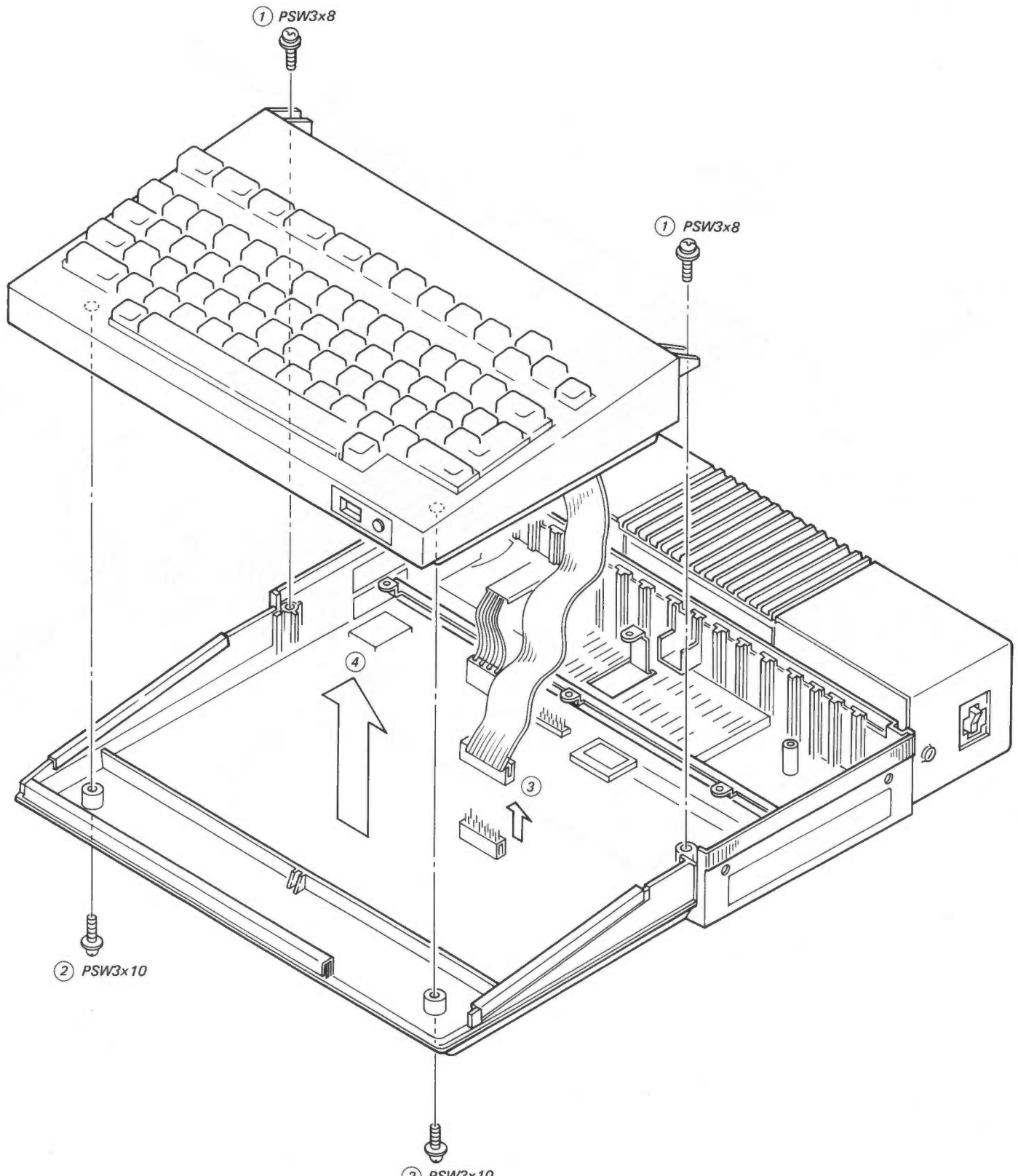


① Remove the screw (PSW3x8).

② Remove the screw (PSW3x10).

③ Pull out the 26-pin connector.

④ Remove the KB panel in the direction indicated by the arrow.



SECTION 2
SERVICE INFORMATION

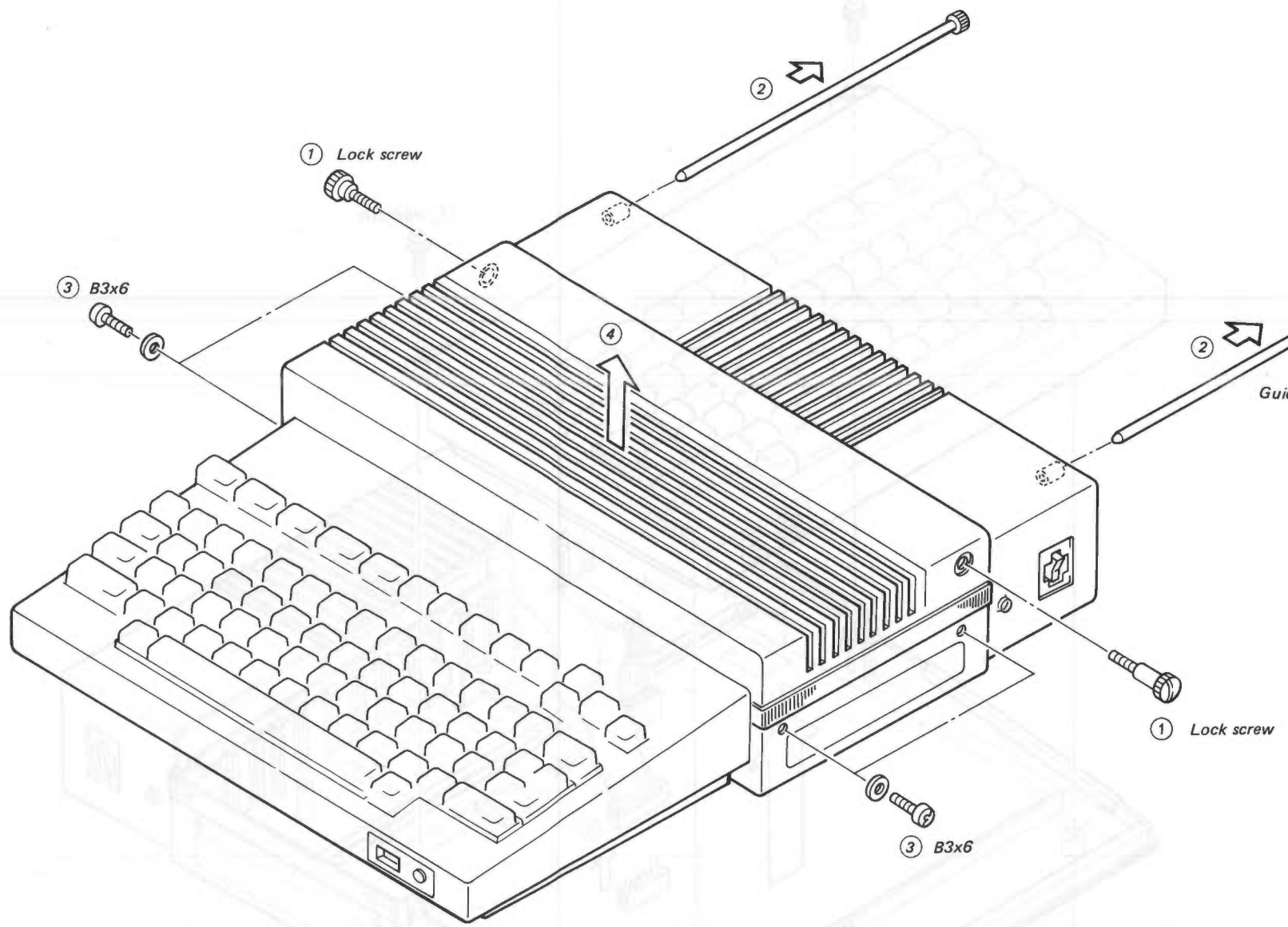
2-1. DISASSEMBLY OF CABINET

(1) Remove the two lock screws.

(2) Pull out the two guide pins.

(3) Remove the four screws (B3x6).

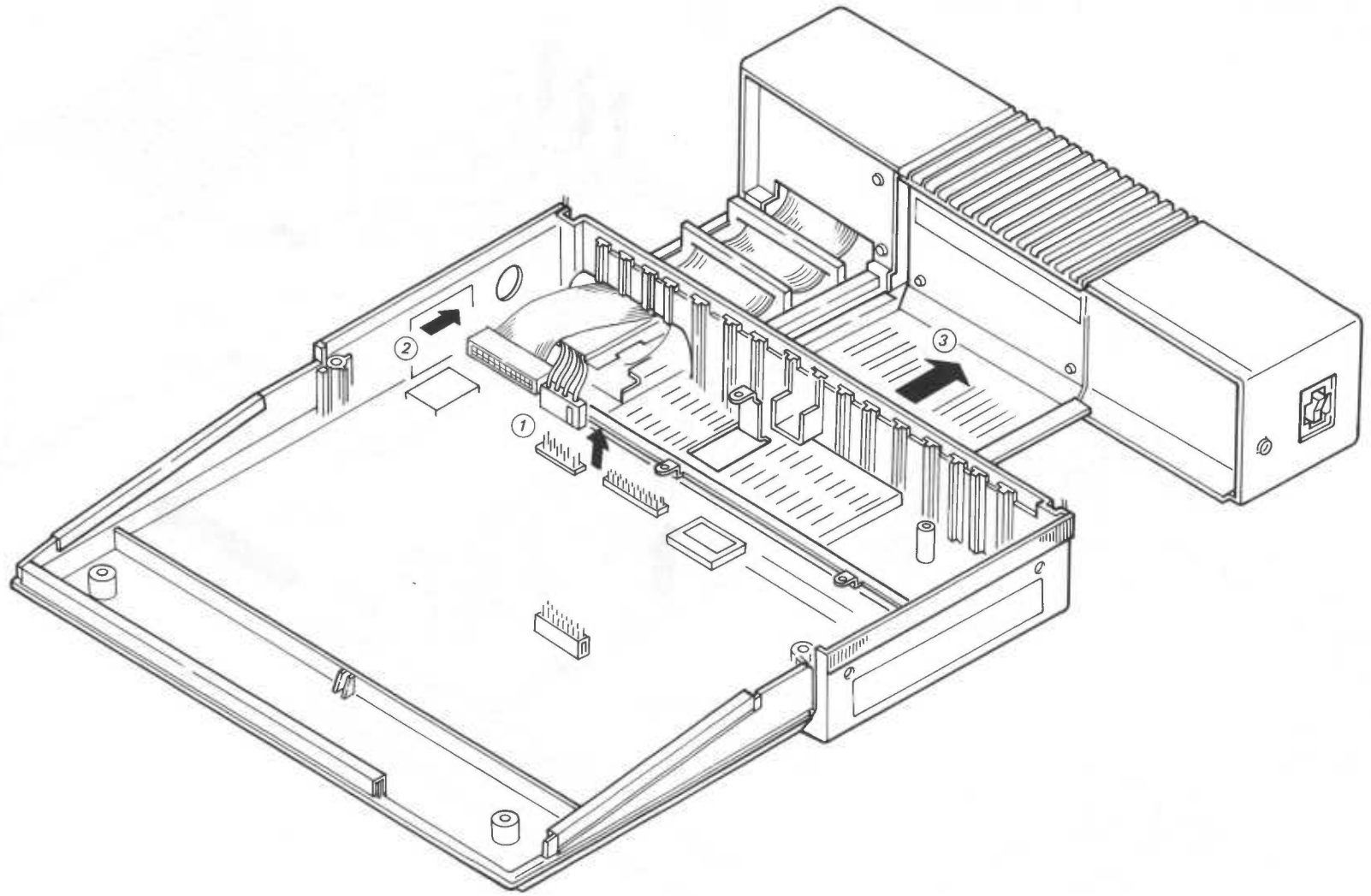
(4) Remove the cabinet (top) in the direction indicated by the arrow.



① Remove the 5-pin connector.

② Remove the 50-pin connector.

③ Pull out the power supply unit fully.



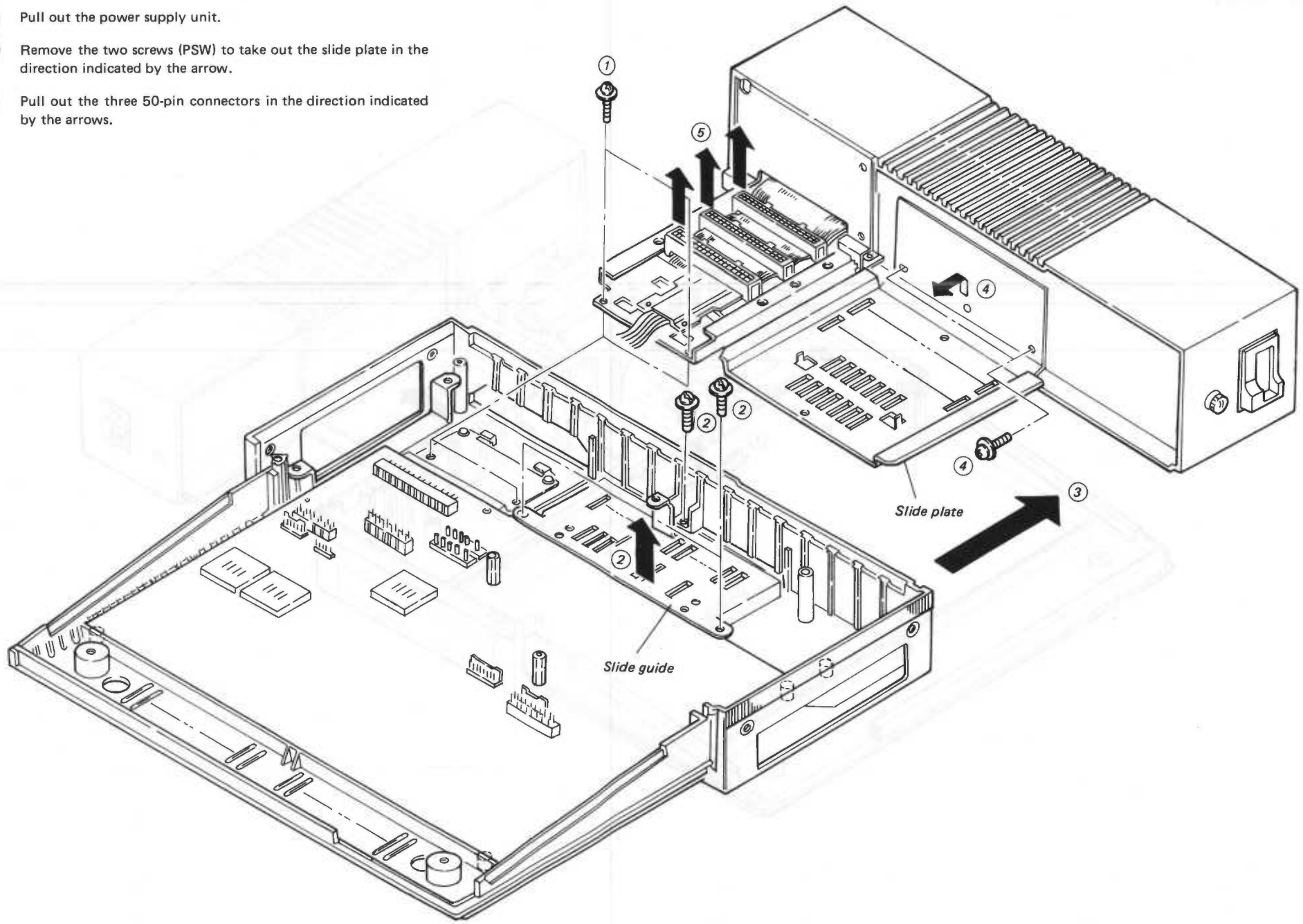
① Remove the two screws (PSW).

② Remove the three screws (PSW) to pull out the slide guide.

③ Pull out the power supply unit.

④ Remove the two screws (PSW) to take out the slide plate in the direction indicated by the arrow.

⑤ Pull out the three 50-pin connectors in the direction indicated by the arrows.



① Remove the two screws (PSW).

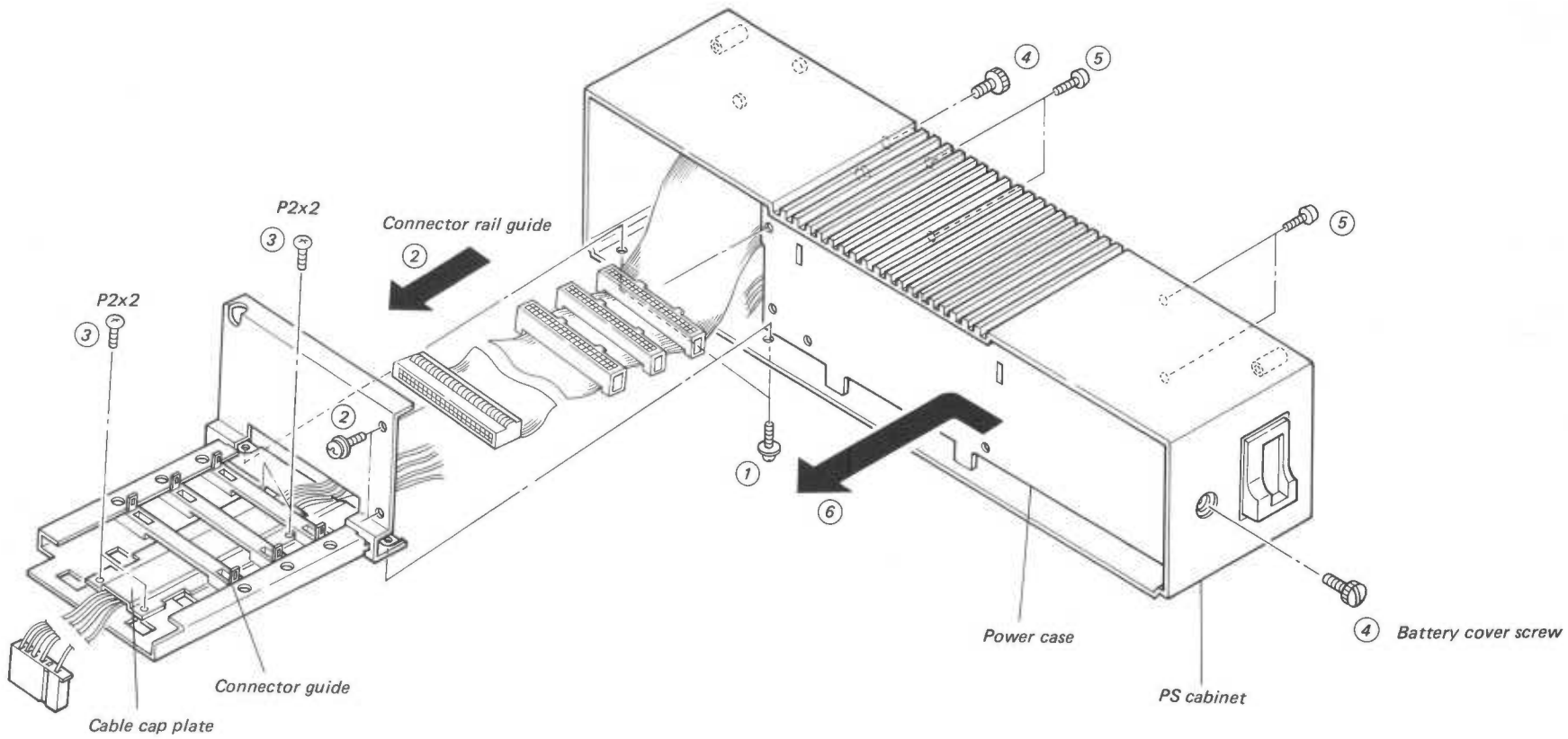
② Remove the screw (PSW) to remove the connector rail guide in the direction indicated by an arrow.

③ Remove the connector and four screws (P2x2) to remove the cable cap plate.

④ Remove the two battery cover screws.

⑤ Remove the four screws (B).

⑥ Pull out the power case in the direction indicated by the arrow.



2-2. SPARE PARTS

① Safety Related Components Warning.
Components identified by shading marked with ⚠ on the schematic diagrams, exploded views and electrical spare parts list are critical to safe operation. Replace these components with Sony parts whose part numbers appear in this manual or in service bulletins and service manual supplements published by Sony.

② Replacement Parts supplied from Sony Parts Center will sometimes have a different shape from the original parts. This is due to "accommodating the improved parts and/or engineering changes" or "standardization of genuine parts".
This manual's exploded views and electrical spare parts list indicate the parts numbers of "the standardized genuine parts at present".
Regarding engineering parts changes in our engineering department, refer to Sony service bulletins and service manual supplements.

③ Printed Components in Bold-Face type on the exploded views and electrical spare parts list are normally stocked for replacement purposes. The remaining parts are not normally required for routine service work. Orders for parts not shown in Bold-Face type will be processed, but allow for additional delivery time.

2-3. FIXTURE AND TOOLS

Part No.	Description
J-6205-290-A	SA Jig Board for SMC-70
J-6200-200-A	KEY TOP DRAWING Jig for SMC-70

Measuring equipment on the market:

HEWLETT PACKARD 5004A . . . SIGNATURE ANALYZER
FREQUENCY COUNTER
VOLTMETER

Sony's products

SMW-7002 . . . CP/M OPERATING SYSTEM

SECTION 3
CIRCUIT DESCRIPTION

3-1. CENTRAL PROCESSING UNIT

The Sony SMC-70 personal computer is based on the powerful Z-80A CPU, making the Sony SMC-70 compatible with the popular CP/M operating system together with the vast range of commercial software that runs under CP/M. The Z-80A handles the processing for the entire system, with the exception of the keyboard which is its own dedicated 8041A microprocessor functioning as a keyboard encoder/interface. Figure 3-1 shows an over-view of the entire Sony SMC-70 system (excluding the power supply and the options). The Z-80A and its associated circuits (clock generation and reset circuit) are shown as a single block.

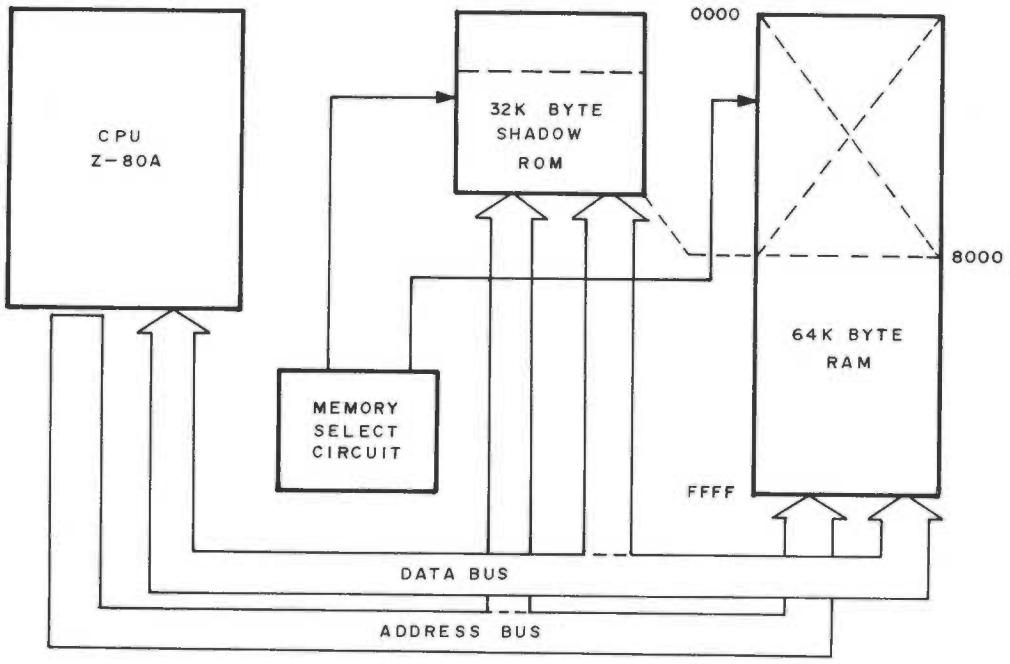


Fig. 3-1. System Overview

The Z-80A

Authorized users of this manual are probably familiar with the Z-80A and are referred to the relevant manufacturer's products manual for details of internal operations, timing etc.

Briefly, the Z-80A is a 40-pin NMOS 8-bit one-chip central processing unit providing 16 address lines, 8 data lines and various status and control signals necessary for integrating with other items in the system such as RAM, ROM, I/O ports etc. since it has no internal memory (except for registers and microcode ROM), every system incorporating a Z-80A requires at a minimum some external RAM and ROM. In the Sony SMC-70, a total of 70KB (71,680 bytes) of RAM is provided, together with 32KB (32,768 bytes) of ROM. Figure 3-2 shows the CPU block and buffers. Since the Z-80A is a MOS device, although its signals are TTL compatible, its drive capabilities are strictly limited and consequently buffering is necessary. The RFSH, M1, IORQ, WR, RD and MREQ control signals are buffered by an 74LS367, as are the address lines, while the data lines use an 74LS245 which controls the direction of data flow.

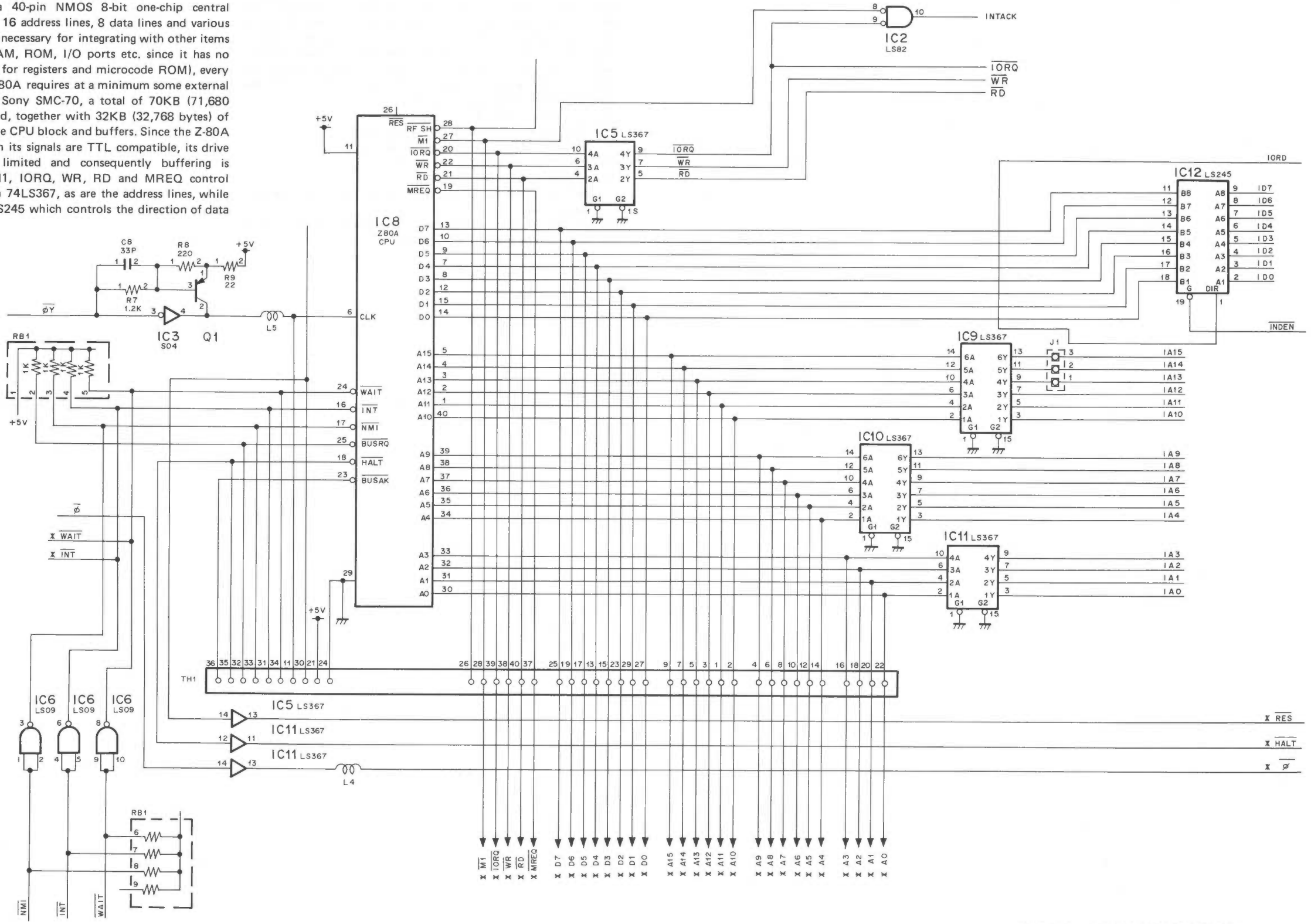


Fig. 3-2. CPU Block and Buffers

Clock generation

The Sony SMC-70 differs from many other personal computers using the Z-80A in that a special LSI provides clocks and timing for the entire system, instead of the usual 2.5MHz or 4MHz system clock. IC16 shown in Figure 3-3 is a special 64-pin LSI that generates all the timing requirements for the whole system, including RAS and CAS for the dynamic memory, WAIT, CRTC/CPU and many other complex timing signals used in various parts of the system. The master clock for IC16 is provided by a 32MHz crystal oscillator. Figure 3-4 shows IC16 in block form; the main signals generated by this LSI include:

1. CPU clock ϕ (4MHz)
2. Main memory dynamic RAM control signals
3. WAIT signals for ROM and graphic RAM access.
4. RAM/ROM switching control signals
5. Graphic RAM control signals.
6. Shift and load clocks for parallel/serial graphic and character data conversion.
7. Switching signals to indicate if the graphic RAM is being addressed by the CPU or the CRTC.

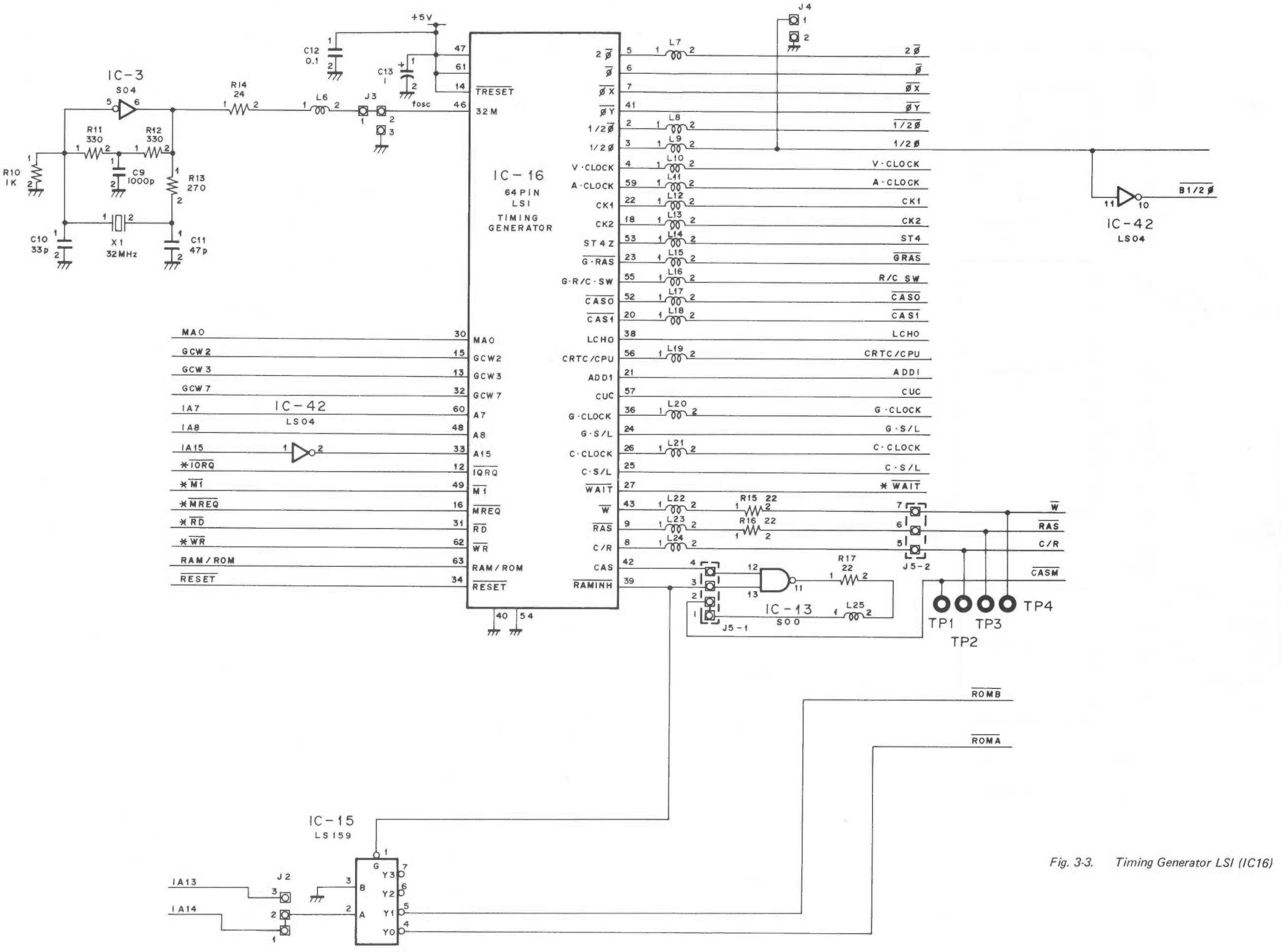


Fig. 3-3. Timing Generator LSI (IC16)

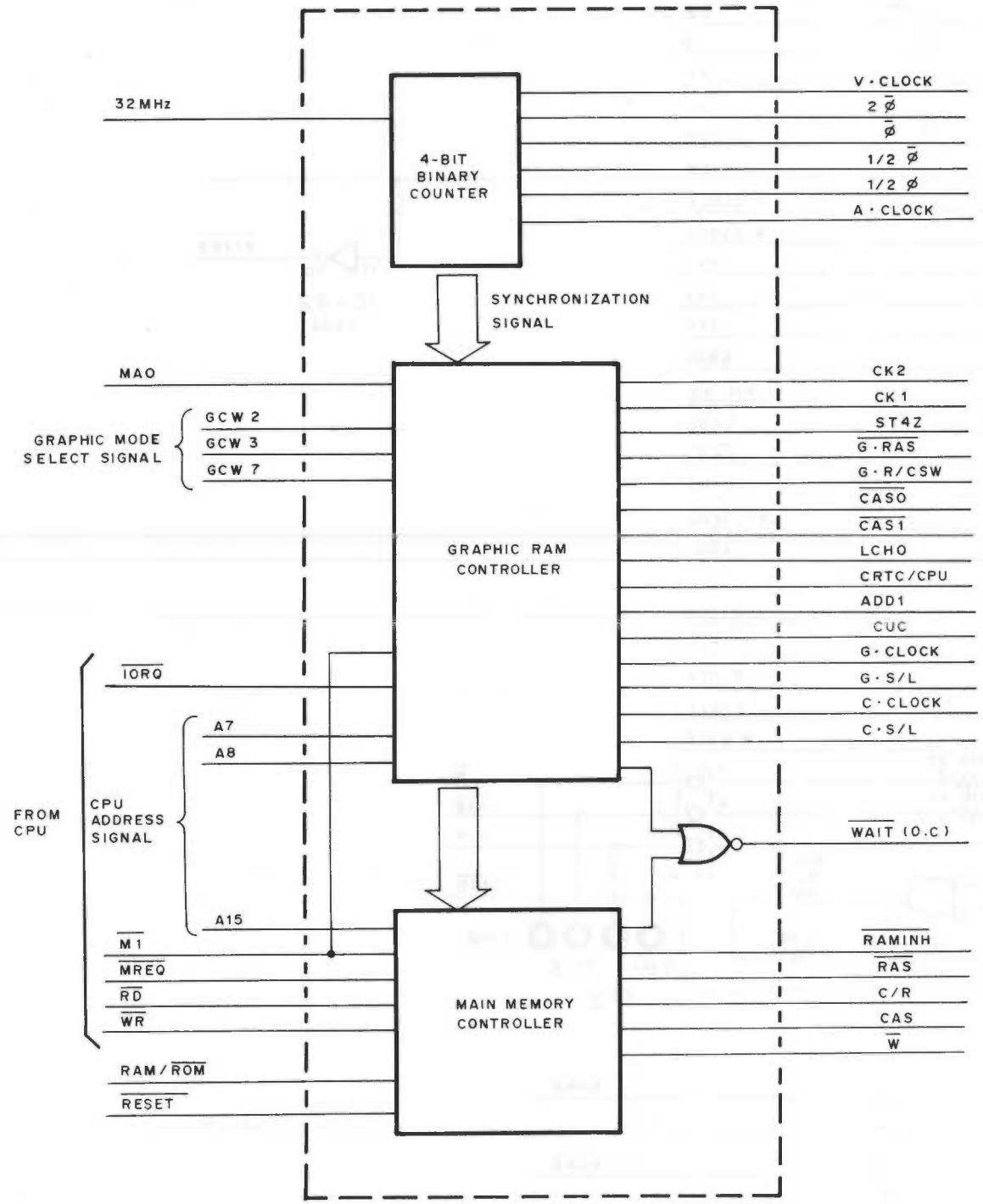
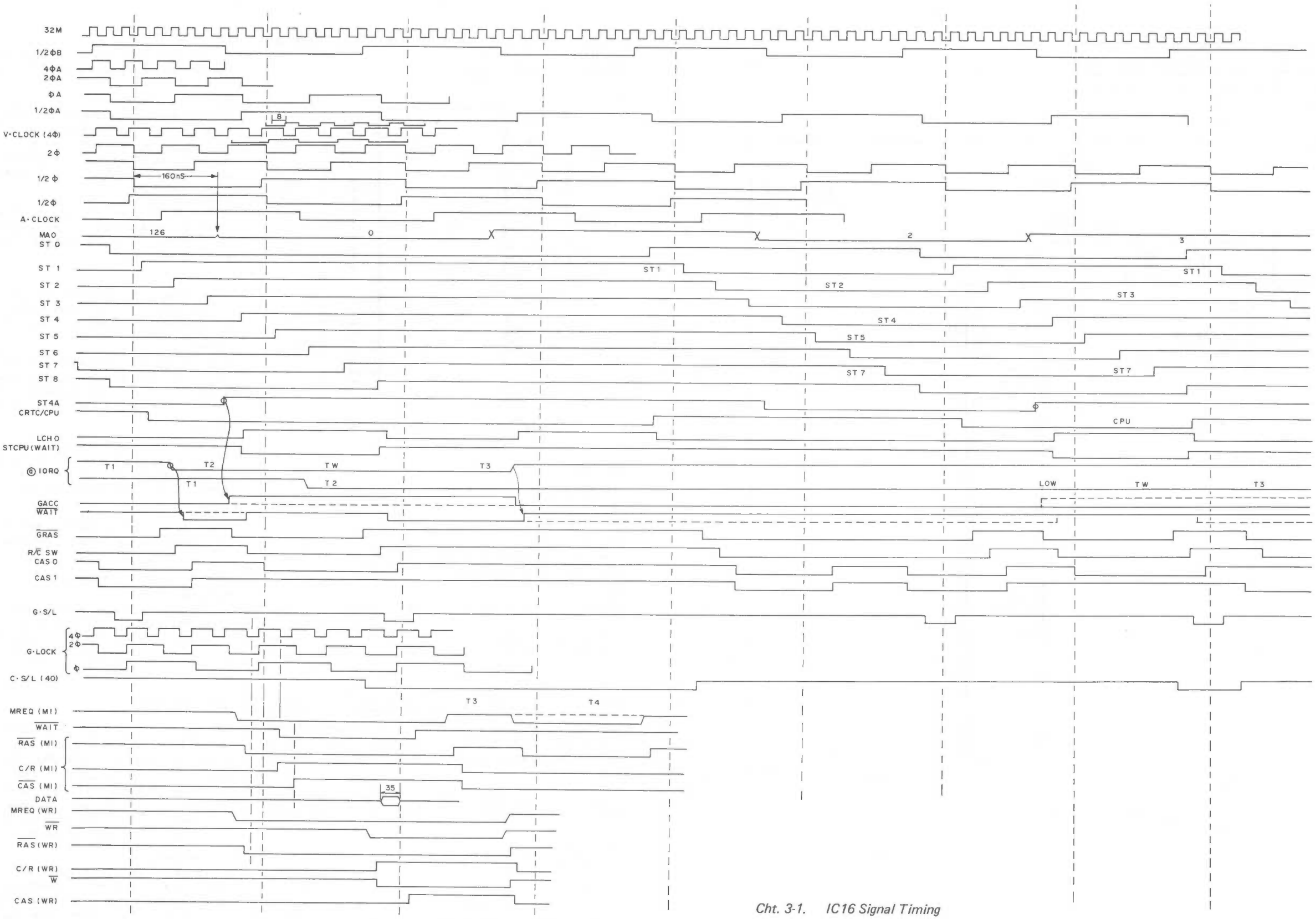


Fig. 3-4. IC16 Block (Timing generator) Diagram

The signals produced by the timing generator LSI are shown in Table 3-1. The timing chart showing the relationship between these timing signals is given in Chart 3-1.

Signal name	Input/ output	Pin No.	Description
32M	Input	46	32MHz basic lock input All clock outputs change at the falling edge of this clock.
V·CLOCK	Output	4	16MHz clock output
2 $\overline{\phi}$	Output	5	8MHz clock output
$\overline{\phi}$	Output	6	4MHz clock output
$\overline{\phi X}$	Output	7	4MHz clock output
$\overline{\phi Y}$	Output	41	4MHz clock output For driving Z-80A
1/2 $\overline{\phi}$	Output	2	2MHz clock output
1/2 ϕ	Output	3	2MHz clock output Reverse phase of 1/2 $\overline{\phi}$
A·CLOCK	Output	59	2MHz clock output 1/2 ϕ delayed for one 32MHz clock
MA0	Input	30	LSB of CPTC refresh address
GCW2	Input	15	Graphic mode select switch 2
GCW3	Input	13	Graphic mode select switch 3
GCW7	Input	32	Graphic mode select switch 7
CK1	Output	22	Graphic RAM output (Byte 1) latch clock
CK2	Output	18	Graphic RAM output (Byte 2) latch clock
ST4Z	Output	53	Graphic data latch output enable signal
$\overline{\text{G·RAS}}$	Output	23	RAS signal to graphic RAM
$\overline{\text{G·R/C SW}}$	Output	55	Graphic RAM row address/column address switching signal
$\overline{\text{CAS0}}$	Output	52	CAS signal to graphic RAM (block 0)
$\overline{\text{CAS1}}$	Output	20	CAS signal to graphic RAM (block 1)
LCH0	Output	38	Clock signal for latching CRTC refresh address
CRTC/CPU	Output	56	Switching signal indicating whether graphic RAM address is sent from CRTC or CPU
ADD1	Output	21	Graphic RAM byte 2 LSB address
CUC	Output	52	Cursor latch clock
G·CLOCK	Output	36	Graphic data shift clock
G·S/L	Output	24	Graphic data load pulse
C·CLOCK	Output	26	Character data shift clock
C·S/L	Output	25	Character data load pulse
$\overline{\text{IORQ}}$	Input	12	CPU $\overline{\text{IORQ}}$ signal
$\overline{\text{M1}}$	Input	49	CPU $\overline{\text{M1}}$ signal
$\overline{\text{MREQ}}$	Input	16	CPU $\overline{\text{MREQ}}$ signal
$\overline{\text{RD}}$	Input	31	CPU $\overline{\text{RD}}$ signal
$\overline{\text{WR}}$	Input	62	CPU $\overline{\text{WR}}$ signal
A7	Input	60	CPU address A7
A8	Input	48	CPU address A8
A15	Input	33	CPU address A15
$\overline{\text{WAIT}}$	Output	27	CPU $\overline{\text{WAIT}}$ input
RAM/ROM	Input	63	Shadow ROM accessible/unaccessible switching signal
$\overline{\text{RESET}}$	Input	34	CPU reset signal
$\overline{\text{RAMINH}}$	Output	39	Signal to inhibit CAS signal to RAM when shadow ROM is accessed
$\overline{\text{RAS}}$	Output	9	RAS signal to dynamic RAM
C/R	Output	8	Dynamic RAM column address/row address switching signal
CAS	Output	42	CAS signal to dynamic RAM
$\overline{\text{W}}$	Output	43	Write signal to dynamic RAM

Table 3-1. IC16 Signals



Cht. 3-1. IC16 Signal Timing

Reset

The reset circuit has been designed so that the system can be reset without the contents of the dynamic memory being destroyed. The reset signal is derived from the OR of the power on reset circuit (IC4, R6 and C7) and the system reset circuit (D-flip-flop IC1 strobed by the RFSH signal). See Figure 3-5.

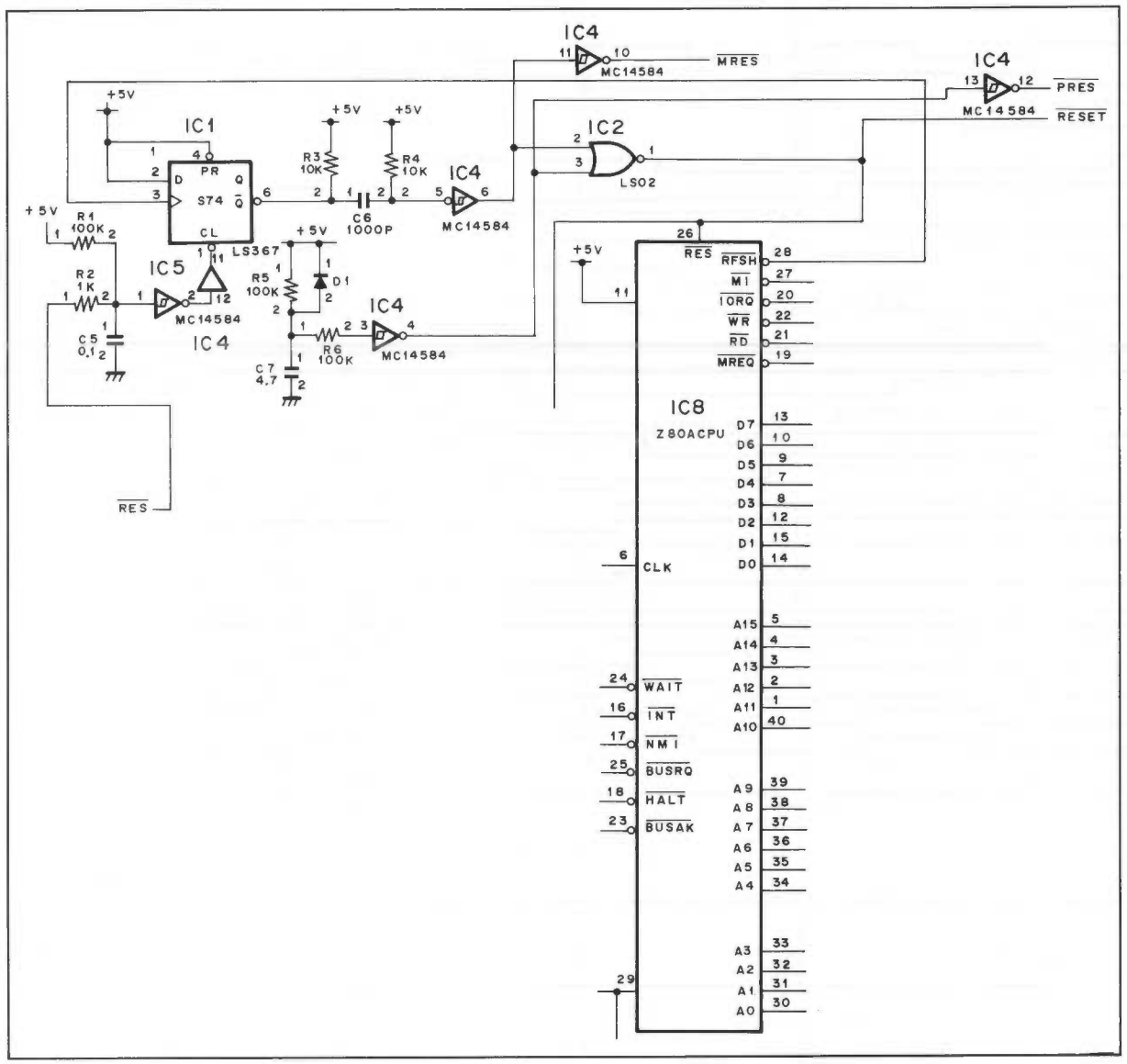


Fig. 3-5. Reset circuit

A system reset holds the Z-80A RES pin low for about 500μsec and the RAM contents are saved.

Z-80A Signals (Refer to Figure 3-6)

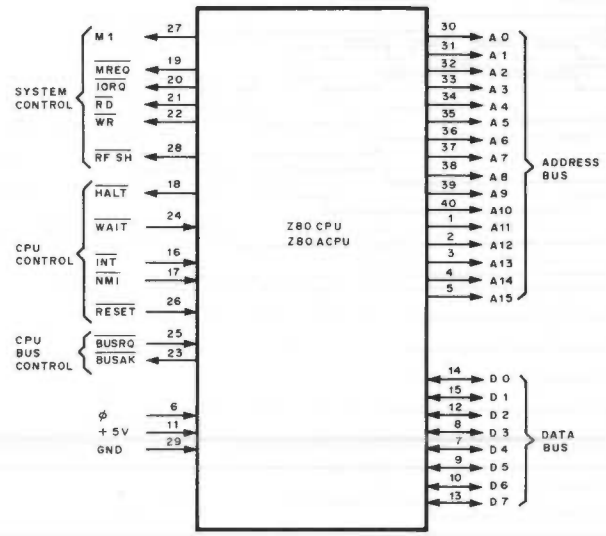


Fig. 3-6. Z-80 Pin Assignment

$A_0 - A_{15}$
The address lines constitute a 16-bit address bus; tri-state, active high. They can address 2^{16} (64K) memory locations.

$D_0 - D_7$
The data lines constitute an 8-bit bidirectional data bus for data exchanges between the CPU and memory or I/O.

$\overline{M1}$
Control signal to indicate an OP code fetch. Active low.

$\overline{MREQ}$
Indicates that address bus address is valid for a memory read or write. Tri-state, active low.

$\overline{IORQ}$
Indicates that $A_0 - A_7$ holds a valid address for an I/O read or write. Note, however, that the SMC-70 is able to I/O address 64K I/O locations owing to a special technique described in Section 3-2. An IORQ is also generated in response to an interrupt so that an interrupt vector can be placed on the data bus.

$\overline{RD}$
The CPU is ready to read memory or an I/O device. The addressed device uses RD to gate data onto the data bus. Tri-state, active low.

$\overline{WR}$
The CPU data bus holds valid data for a write to memory or I/O. Tri-state, active low.

$\overline{RFSH}$
Indicates that the lower 7 bits of the address bus contain a refresh address. Used by dynamic memories to refresh memory contents. Active low.

$\overline{HALT}$
The CPU has executed a software halt. The CPU executes NOPs (so that dynamic memory will not be lost) until an interrupt occurs.

$\overline{WAIT}$
This is an active low input signal that indicates to the CPU that the addressed location (usually I/O) is not ready to transfer data. The CPU automatically adds wait states as long as this signal is active. However, it should be noted that the contents of dynamic RAM cannot be guaranteed if the WAIT period exceeds 2msec at a time.

$\overline{INT}$
When an INT (Interrupt Request) signal is received, if the software controllable interrupt enable flip-flop is in the enable state, the request will be serviced at the end of the instruction currently being executed. Active low.

$\overline{NMI}$
This interrupt request is non-maskable and will always be serviced at the end of the current instruction. NMI is not used in the SMC-70, but the signal line is available on pin 50 of CN10.

$\overline{RESET}$
When this input is true (active low), the CPU is initialized by resetting the interrupt flip-flop, clearing the I, R and PC registers, setting the interrupt mode to mode 1, tri-stating the address and data lines and making all control output signals inactive.

$\overline{BUSRQ}$
This active low input forces the CPU to tri-state address, data and tri-state output control signals so that other devices can take control of these busses. It is used for DMAs, but the SMC-70 as presently configured, does not use DMA for memory transfers.

$\overline{BUSAK}$
This is the active low output signal that indicates that the CPU has tri-stated the lines described above under BUSRQ.

ϕ
This is the clock input (4.028MHz).

Buffering
All the Z-80A input and output signals used by the system are buffered as described above. The buffers provide the drive necessary for driving the many components connected to the address, data and control buses as well as for protecting the CPU.

3-2. MEMORY

The SMC-70 is provided with a very large amount of memory, 64KB of user RAM, 32KB of program ROM, 32KB of GRAM (graphic RAM) and 6KB of additional RAM for holding video attributes, the character set and character font. Since the Z-80A is an 8-bit microcomputer with only 16 address lines, it is clear that not all of this memory can be addressed simultaneously. The SMC-70 uses a combination of bank switching and a special I/O addressing technique in order to utilize all this memory.

1. Main Memory

Figure 3-7 shows the main memory and system ROM.

The main memory consists of 64KB of dynamic RAM comprising eight 4164 64K x 1 bit chips. As the 4164s have only eight address pins, the address has to be multiplexed and two 74S257s (IC17, 18) are used for this, with the data selection controlled by the C/R line connected to pin 1. The timing for the C/R signal is generated in IC16 (the 64 pin timing generator described earlier) pin 8

Chart 3-2 shows the dynamic RAM timing.

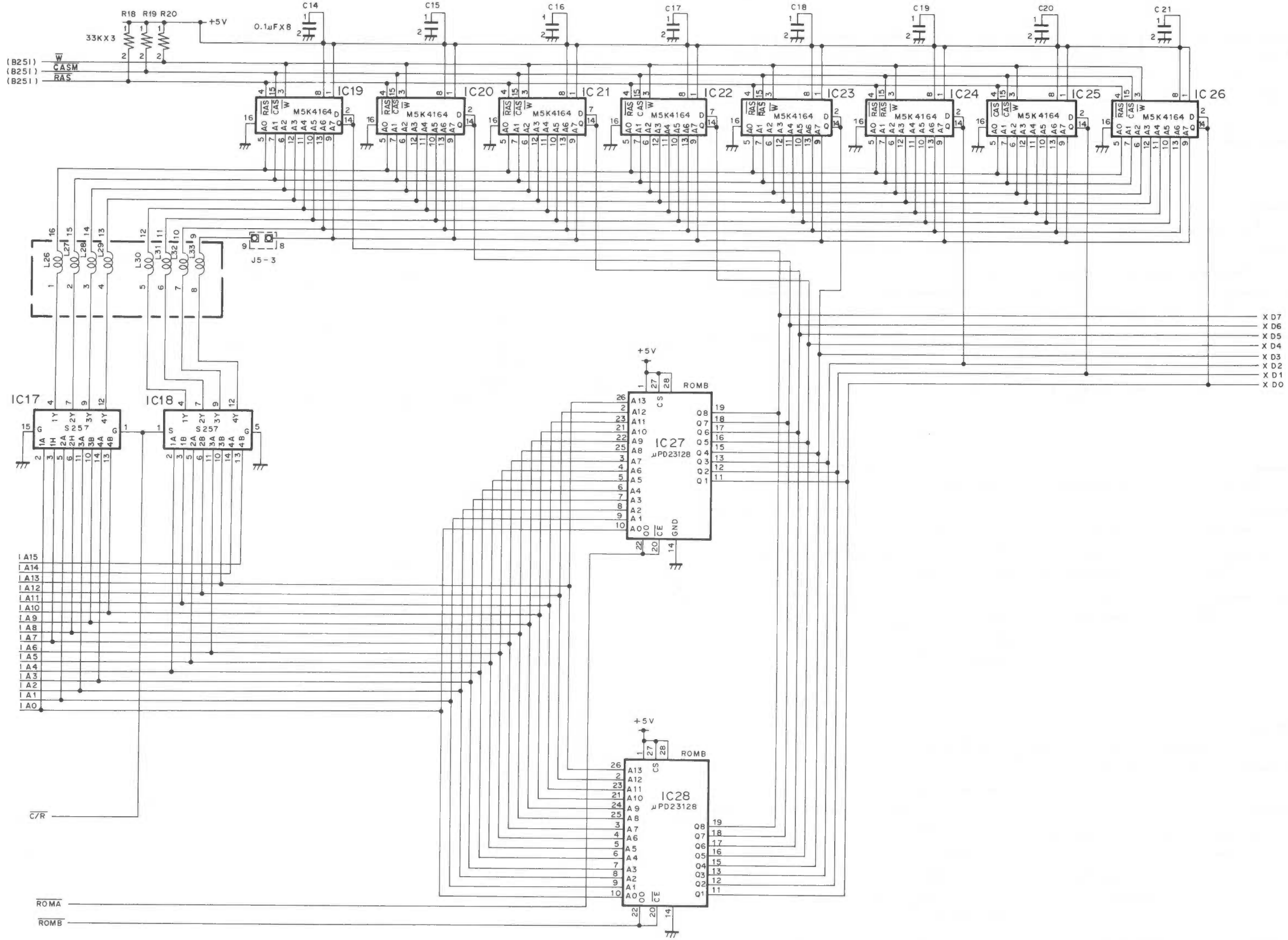
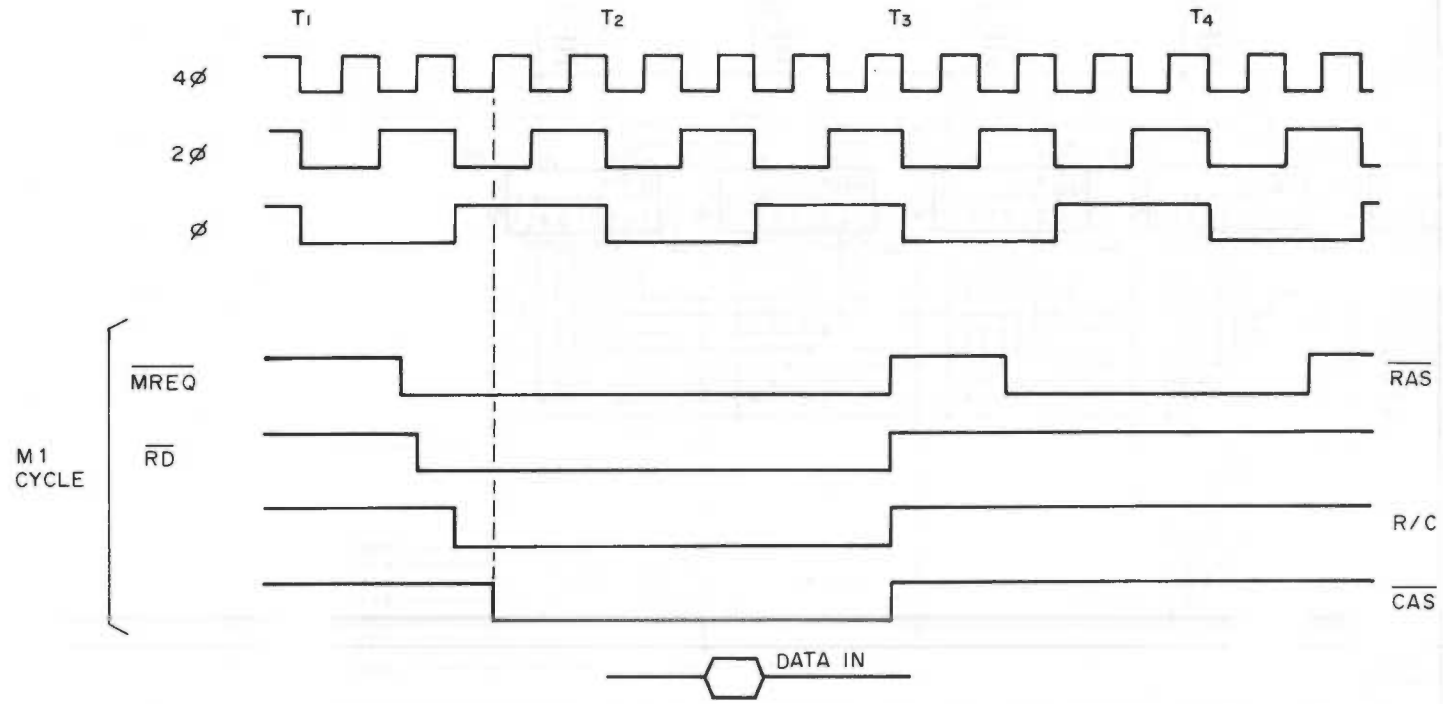


Fig. 3-7. Main Memory



Cht. 3-2. DRAM Timing

2. ROM

32KB of ROM is provided by two μPD23128s which contain the system monitor, Sony BASIC and other software needed by the system. These are labeled ROMA and ROMB respectively and they are enabled by the ROMA and ROMB lines. These lines are made true when $\overline{\text{RAMINH}}$ (RAM Inhibit) from the timing generator is true. $\overline{\text{RAMINH}}$ enables IC15 (an 74LS139 2-4 line decoder) which makes either ROMA or ROMB true depending on the state of address line 1A14. Since the μPD23128 chips are 16KB memory devices, they use fourteen address lines $A_0 - A_{13}$ while A_{14} is used to decide which chip will be active as described above.

The 32KB of ROM actually occupies the same logical address space as the RAM and bank switching between the two is possible. At power on, the ROM is automatically enabled and the ROM is mapped from address 0000_H. The data lines of the chips do not have any special buffering apart from the 74LS245 octal bus transceiver (IC12). When RAMINH from the Timing Generator (IC16) goes true, the ROM is enable while the bottom half of the RAM is read disabled, though writing to RAM is still possible.

3. Video Memory

The video memory used in the SMC-70 is unique in two respects; it is very large (38KB) and it is I/O addressed. The video memory is divided into the following functional blocks; GRAM (Graphics RAM; 32KB), CRAM (character RAM; 2KB), ARAM (attribute RAM; 2KB) and PCGRAM (programmable character generator RAM; 2KB).

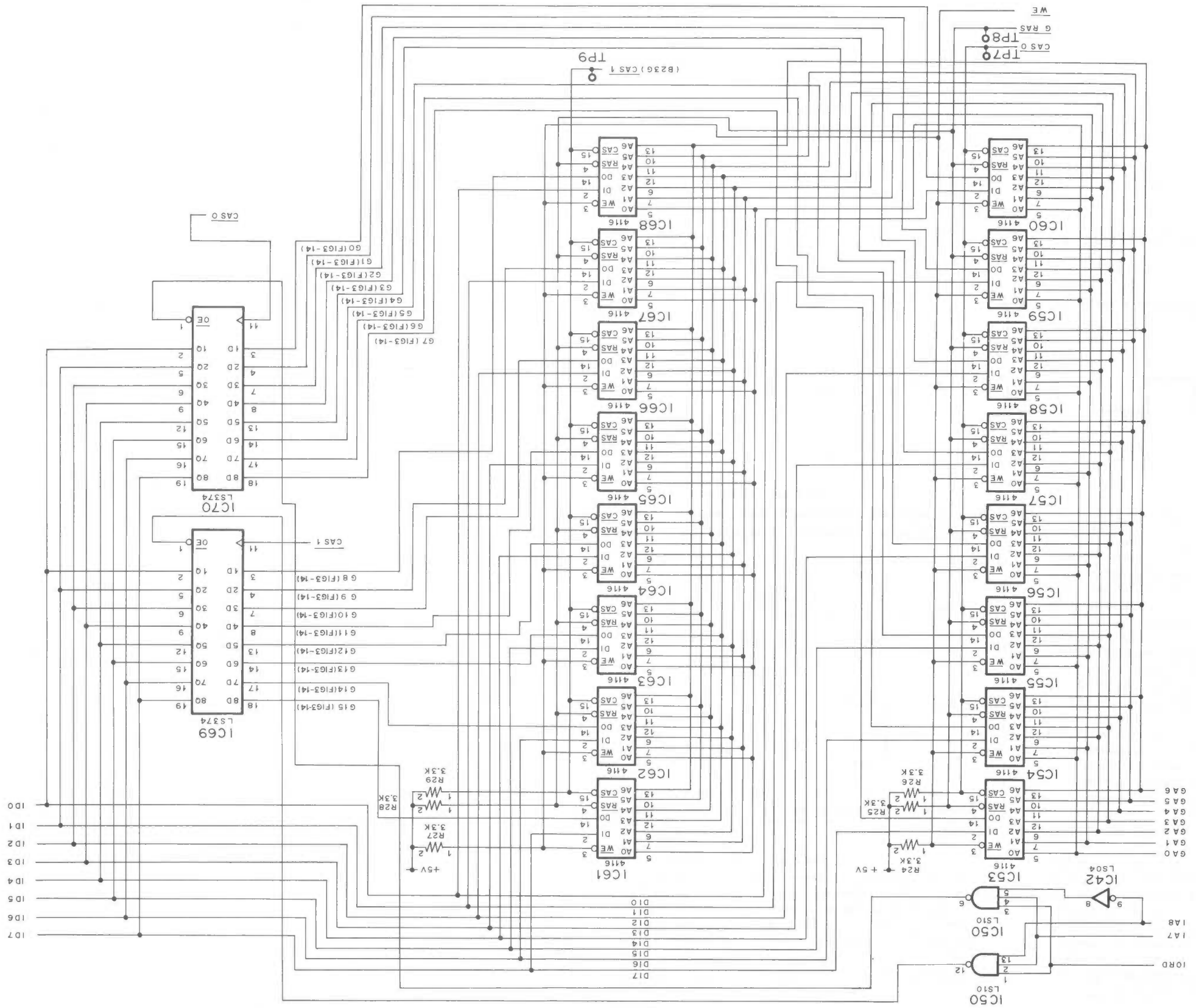


Fig. 3-8. GRAM Memory

GRAM

Figure 3-8 shows the graphic memory (GRAM).

The 32KB of GRAM are derived from 16 4116 type dynamic RAMs. As is usual with dynamic RAM, only "half" the number of address pins required is present and addressing is by means of multiplexing the row address and the column address separately onto the pins. In Z-80A systems the upper eight address lines are normally not used during an I/O operation since they contain the contents of the A register. However, in the SMC-70, address lines A_0 to A_{14} are used (in order to address 32KB).

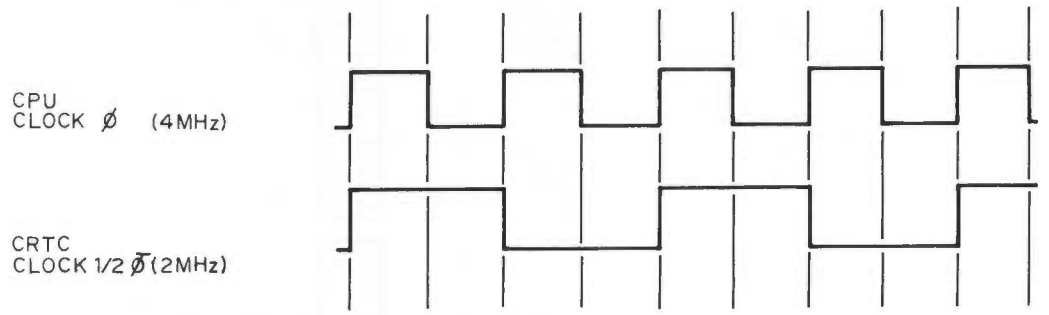
Normal Z-80 I/O read/write	SMC-70 Z-80 I/O read/write	GRAM Addr. Lines
A15 [contents of A reg.] A8	A15 [contents of B reg.] A8	A15 A8
A7 nn A0	A7 [contents of C reg.] A0	A7 A0

Fig. 3-9. I/O Addressing. The contents of the B and C registers are mapped onto address lines A_0–A_7 respectively. See text.

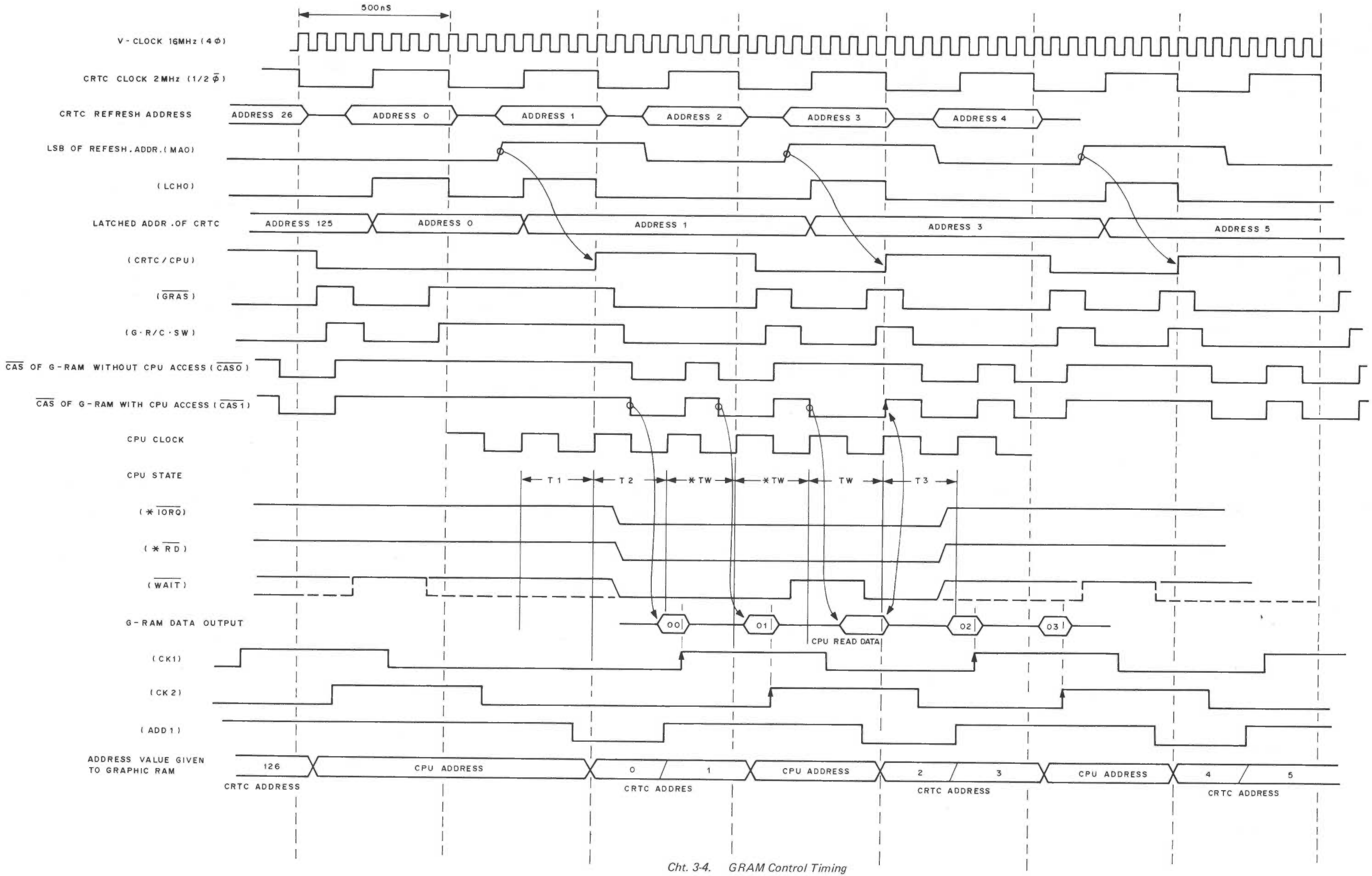
In the SMC-70, address line A_7 is used to select GRAM. When it is 1, GRAM is selected, and when it is 0, normal I/O (such as the RS232C, and also ARAM, GRAM & PCG) is selected. At first sight, A_7 might seem a strange choice for switching the GRAM since it comes right in the middle of the address lines. However, the lower 8 bits and the upper 8 bits of the address bus are inverted, so that A_0 – A_7 become the upper 8 bits, while A_8 –A A_{15} become the lower 8 bits. This is done principally because the B register decrements automatically, and since the contents of the B register appear on the upper 8 bits, the LSB of the upper byte would decrement in the middle of the address bus, causing all kinds of strange phenomena on the screen during, for example, a block move. By reversing the upper and lower bytes, the "new" LSB is the one that decrements. A_7 of the CPU address bus also now appears as the highest address line and so it can be used for GRAM/I/O switching without causing any problems. By I/O mapping the video memory in this way, a huge screen memory becomes available without eating into the user memory space.

The graphic RAM time-shares buses and is accessed from the CPU and CRTC. The sampling signal of the LSB of the refresh address output from the CRTC is used for switching the CPU/CRTC bus for access to the graphic RAM. This signal is a clock of about 1MHz. While this clock is high, the CRTC reads the graphic RAM. While it is low, the CPU reads or writes the graphic RAM. Since the CRTC refresh cycle is 2MHz, it reads two bytes per block (in page mode). A total of four bytes is read from two blocks and held in the D-latches until it is sent out sequentially to the parallel/serial conversion circuit. Chart 3-3 shows the relationship between the CPU clock ϕ and the CRTC clock ϕ.

The GRAM control timing is shown in Chart 3-4.



Cht. 3-3. CPU/CRTC Clock Relationship



Cht. 3-4. GRAM Control Timing

3-3. VIDEO BLOCK

The video system consists of the following sections:

1. Graphic RAM (32KB)
2. Character RAM (2KB)
3. Attribute RAM (2KB)
4. Programmable character generator RAM
5. HD46505S CRTC
6. Graphic mode multiplexer LSI
7. Graphic mixer LSI
8. CPU interface
9. Analog conversion

1. Graphic RAM

The graphic RAM is accessed by both the CPU and the HD46505 CRTC with switching provided by the CRTC/CPU output of the timing generator LSI. The GRAM addressing circuit is shown in Figure 3-10.

While this signal is high, the CRTC reads the graphic RAM and while it is low, the CPU is able to write to or read from the graphic RAM. The graphic RAM consists of two blocks, block 0 and block 1, of 16KB each. The CPU sees these blocks as even and odd addresses respectively. Viewed from the CRTC, these blocks have the same refresh addresses. The relationship between these addresses is shown in Table 3-2.

GRAM ADDRESS	Column address							Row address						
	A6	A5	A4	A3	A2	A1	A0	A6	A5	A4	A3	A2	A1	A0
No	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CPU ADDRESS	A6	A5	A4	A3	A2	A1	A9	A0	A15	A14	A13	A12	A11	A10
CRTC REF. ADDRESS	XRA2	XRA1	Note 3 XRA0	MA10	MA9	MA8	Note 2 *	MA7	MA6	MA5	MA4	MA3	MA2	MA1

Tab. 3-2. GRAM Addresses

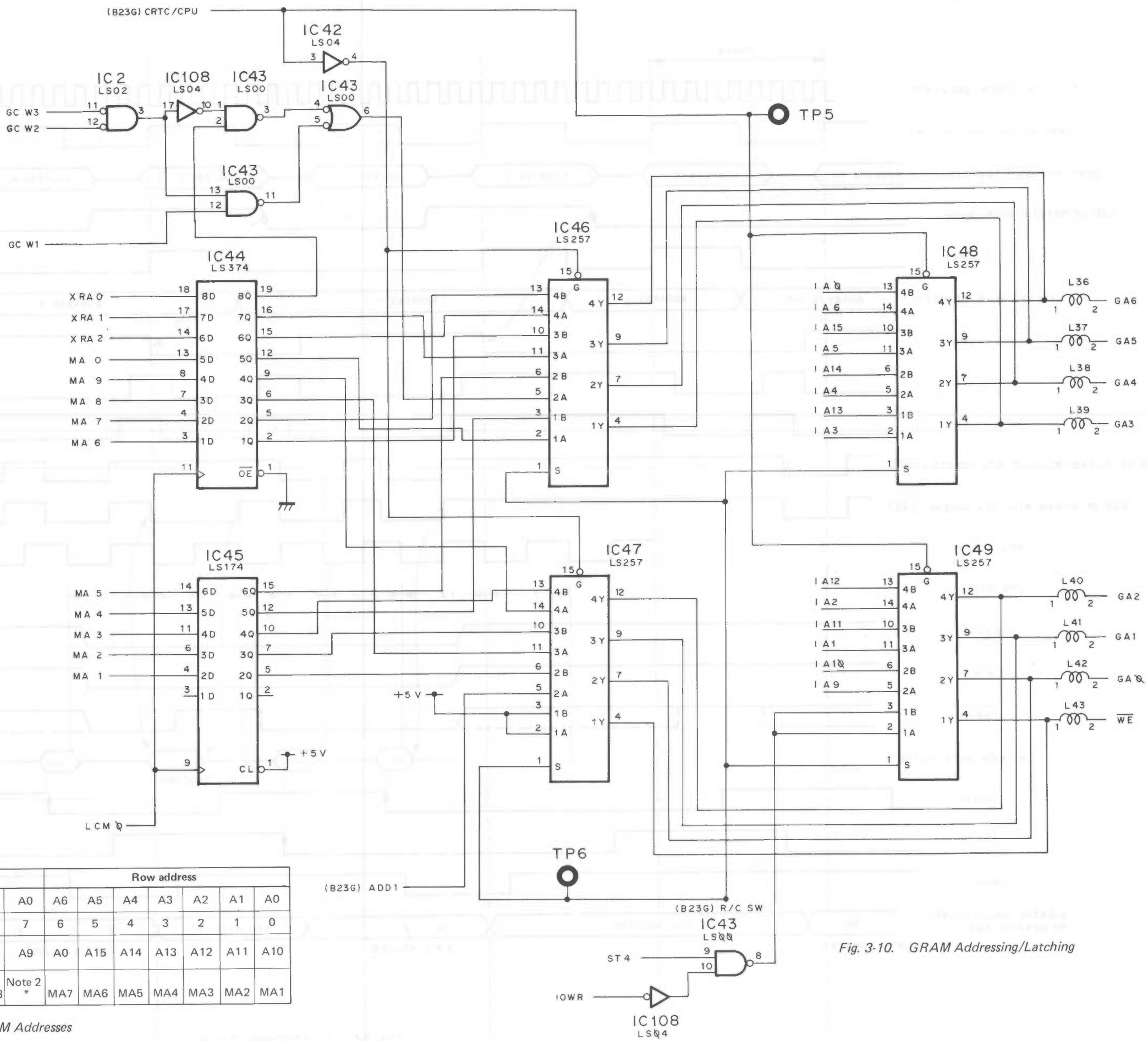


Fig. 3-10. GRAM Addressing/Latching

The CRTC refresh cycle is 2.014MHz and when the CRTC read data from the graphic RAM, it reads two byte's worth and this 16 bits of data is held in D-latches (IC69, 70; 74LS374). Wait states are automatically added while the CRTC is accessing the graphic RAM.

2. CRAM, ARAM & PCG Address Decoding

The decoding circuit for the CRAM, ARAM and PCG is given in Figure 3-11. Figure 3-12 shows the CRAM and ARAM. ICs 78, 79 and 80 are for CPU/CRTC switching.

3. Character RAM

The character RAM (IC81) is a 2KB device that stores the codes that identify each producible character. Like the graphic RAM, is too is accessed by both the CPU and the CRTC. It is buffered by IC83 (74LS245) and the data is latched by IC85 (74LS374), which latches the data when the character RAM is read by the CRTC. IC83 and IC84 buffer the CRAM and ARAM respectively. IC85 latches the CRAM output when read by the CRTC.

4. Attribute RAM

This again is a 2KB RAM accessed by both the CPU and CRTC and buffered in exactly the same way as the character RAM.

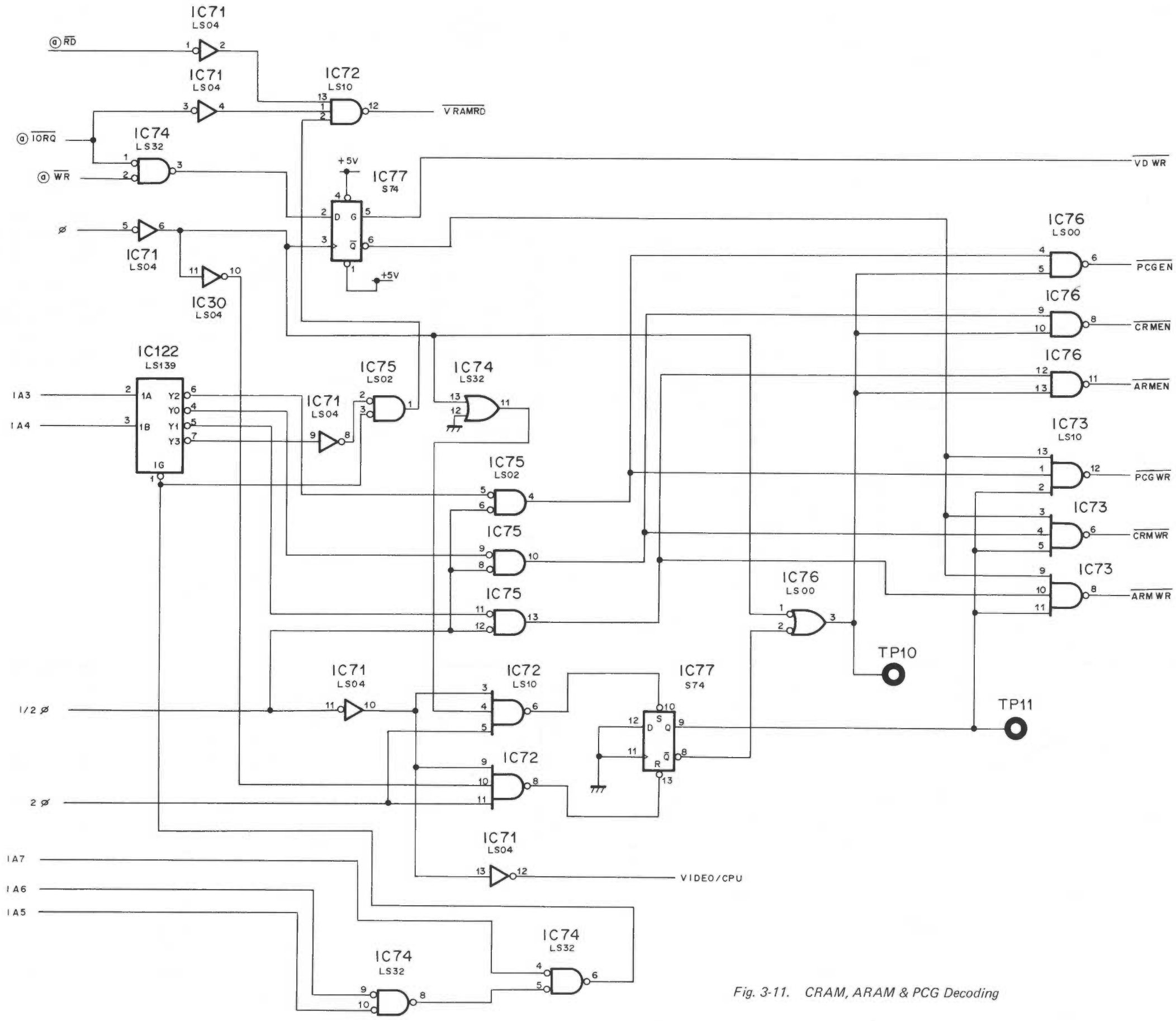


Fig. 3-11. CRAM, ARAM & PCG Decoding

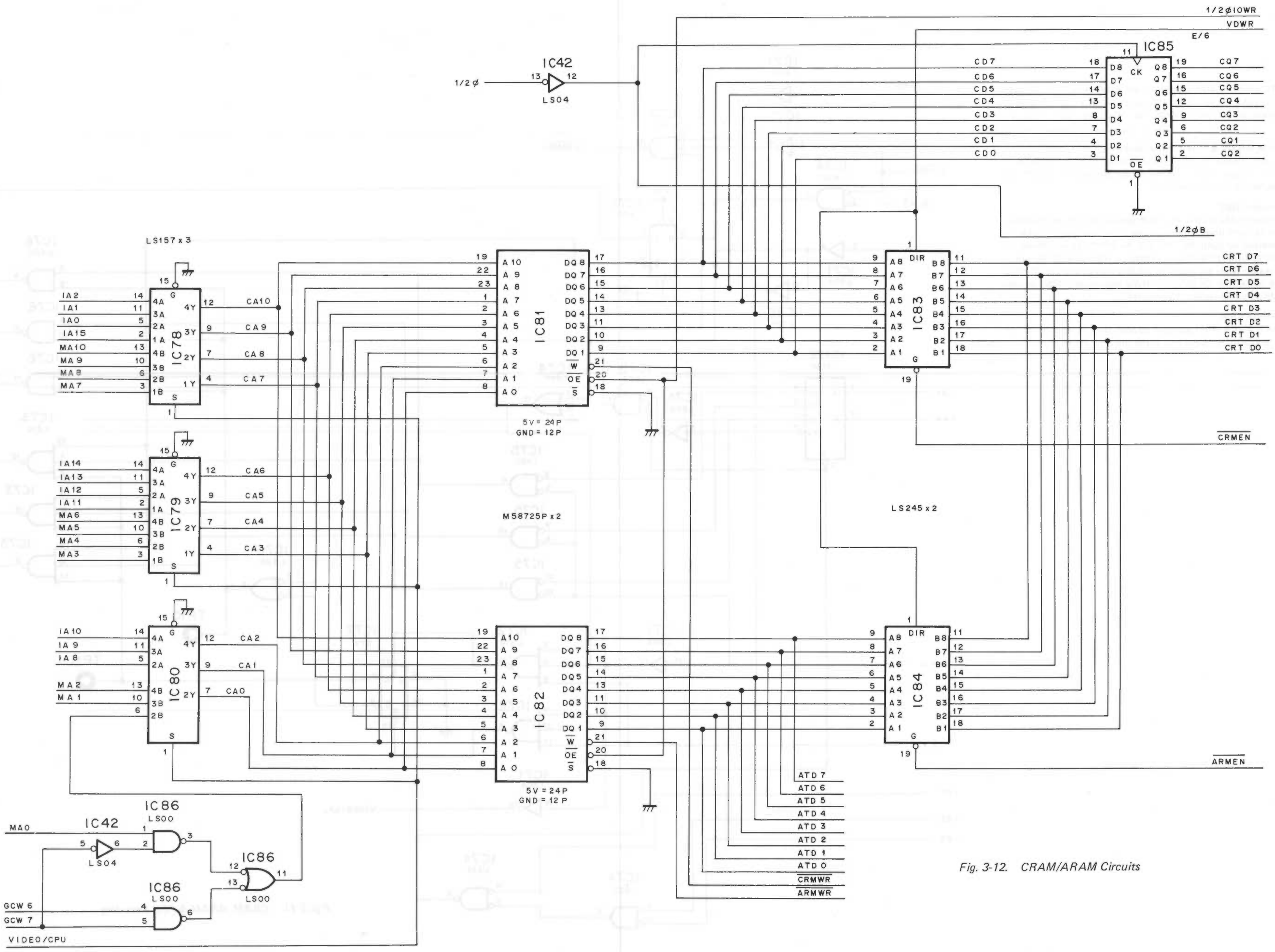
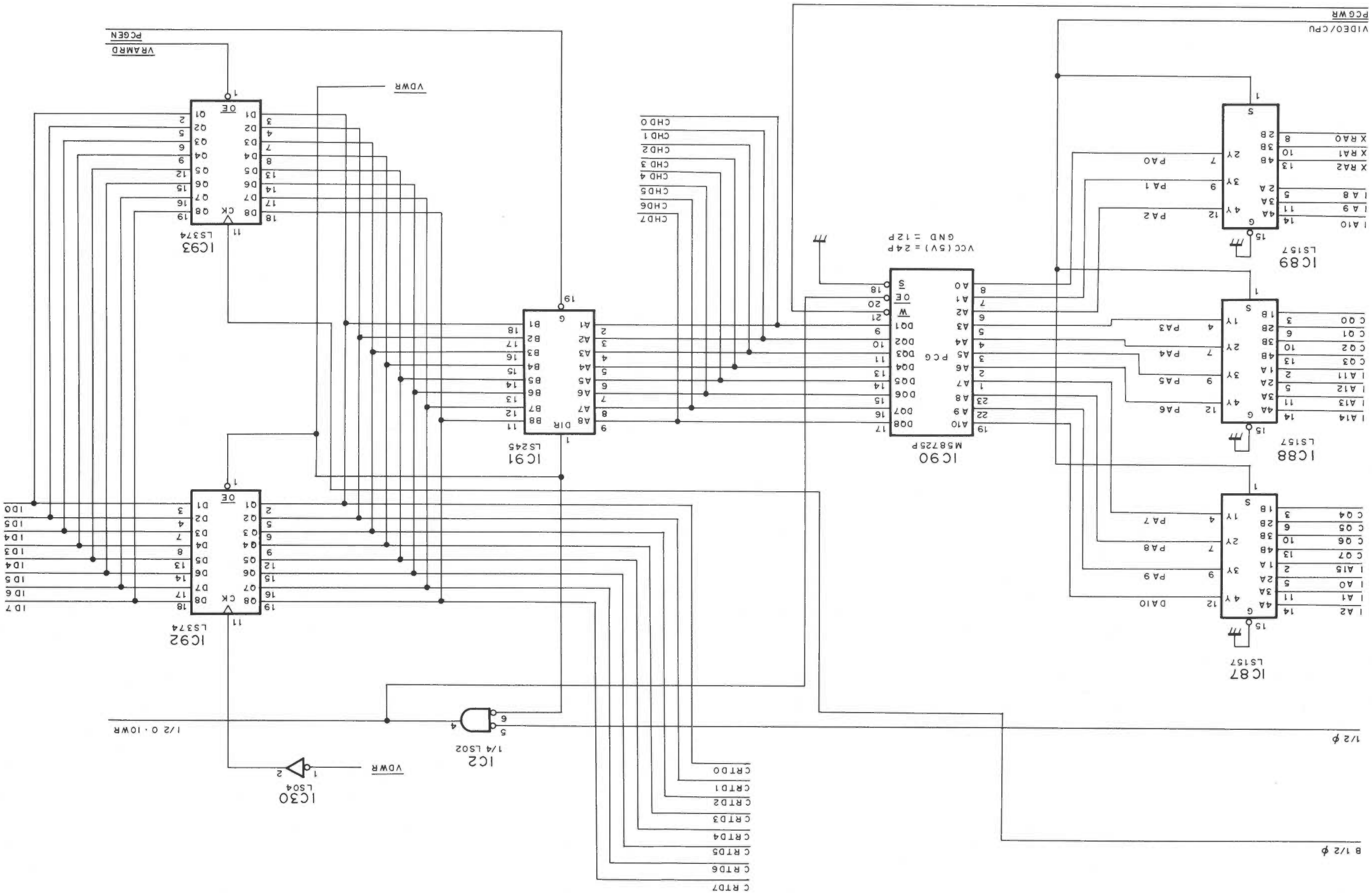


Fig. 3-12. CRAM/ARAM Circuits


IC93
LS374
IC91
LS245
IC90
M58725P
VCC (5V) = 24P
GND = 12P
IC89
LS157
IC88
LS157
IC87
LS157
IC92
LS374
IC30
LS04
IC2
1/4 LS02
VRAMRD
PCGEN
VDWR
VIDEO/CPU
PCGWR
CHD0
CHD1
CHD2
CHD3
CHD4
CHD5
CHD6
CHD7
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA8
PA9
DA10
X RA0
X RA1
X RA2
C RTD0
C RTD1
C RTD2
C RTD3
C RTD4
C RTD5
C RTD6
C RTD7
1/2 O · 10WR
1/2 φ
B 1/2 φ

5. Programmable Character Generator RAM

Figure 3-13 shows the PCG.

This is the 2KB RAM that contains the actual bit data for each character as specified by the character RAM. It is accessed by both the CPU and the CRTC. Its outputs (data) are buffered by IC91 (74LS245) and latched onto the CPU data bus by IC92 (CPU write) and IC93 (CPU read).

Shift and load

The two bytes of graphics data latched in IC69 and 70 are read twice and latched in ICs 101, 102, 103 and 104 since the graphics data is converted to serial form four bytes at a time. The attribute data is latched by IC97 and then shifted in three steps by shift registers IC98, 99 & 100. Similarly, the character bit data is latched by IC94 and shifted twice by IC95 & 96. The purpose of these shift registers is to equalize the timing so that all the information (graphic, character and attribute) can appear on the screen with the correct timing relationship. The shift and load clock signals are shown in Chart 3-5. Having undergone all this latching and shifting, the data that is destined for the CRT display enters the multiplexer and mixer LSIs. The shift and load registers are shown in Figure 3-14.

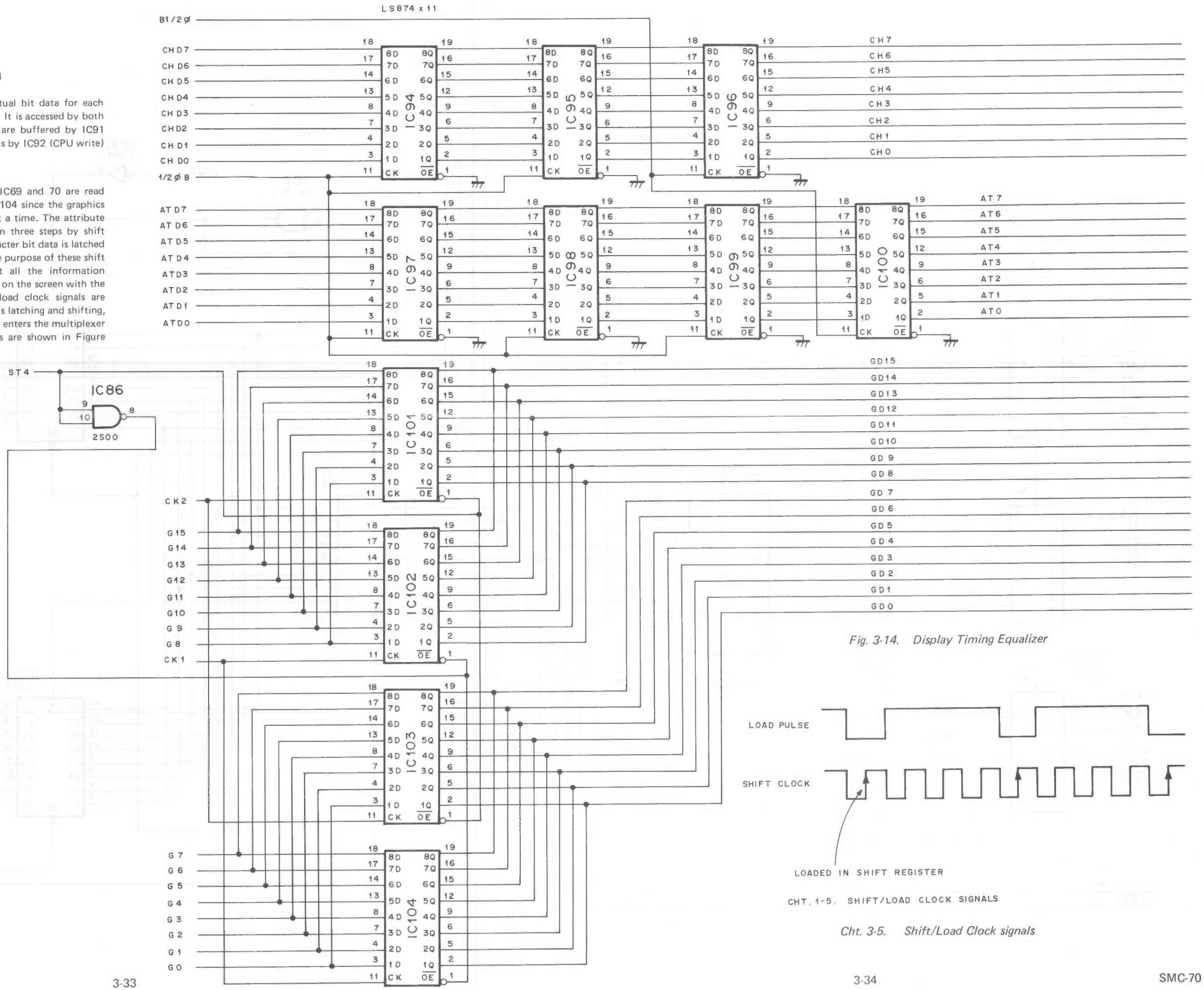


Fig. 3-14. Display Timing Equalizer

Cht. 3-5. Shift/Load Clock signals

6. Graphic Mode Multiplexer LSI

This LSI has two primary functions; to get the display data from the graphic data buffers and output 4 bit X, R, G & B data, and to skew the outputs. It is shown in Figure 3-15.

7. Graphic mixer LSI

This LSI outputs 4 bits, X, $\overline{X}$, $\overline{R}$, $\overline{G}$ & $\overline{B}$ which form the color video signal. This LSI is also shown in Figure 3-15.

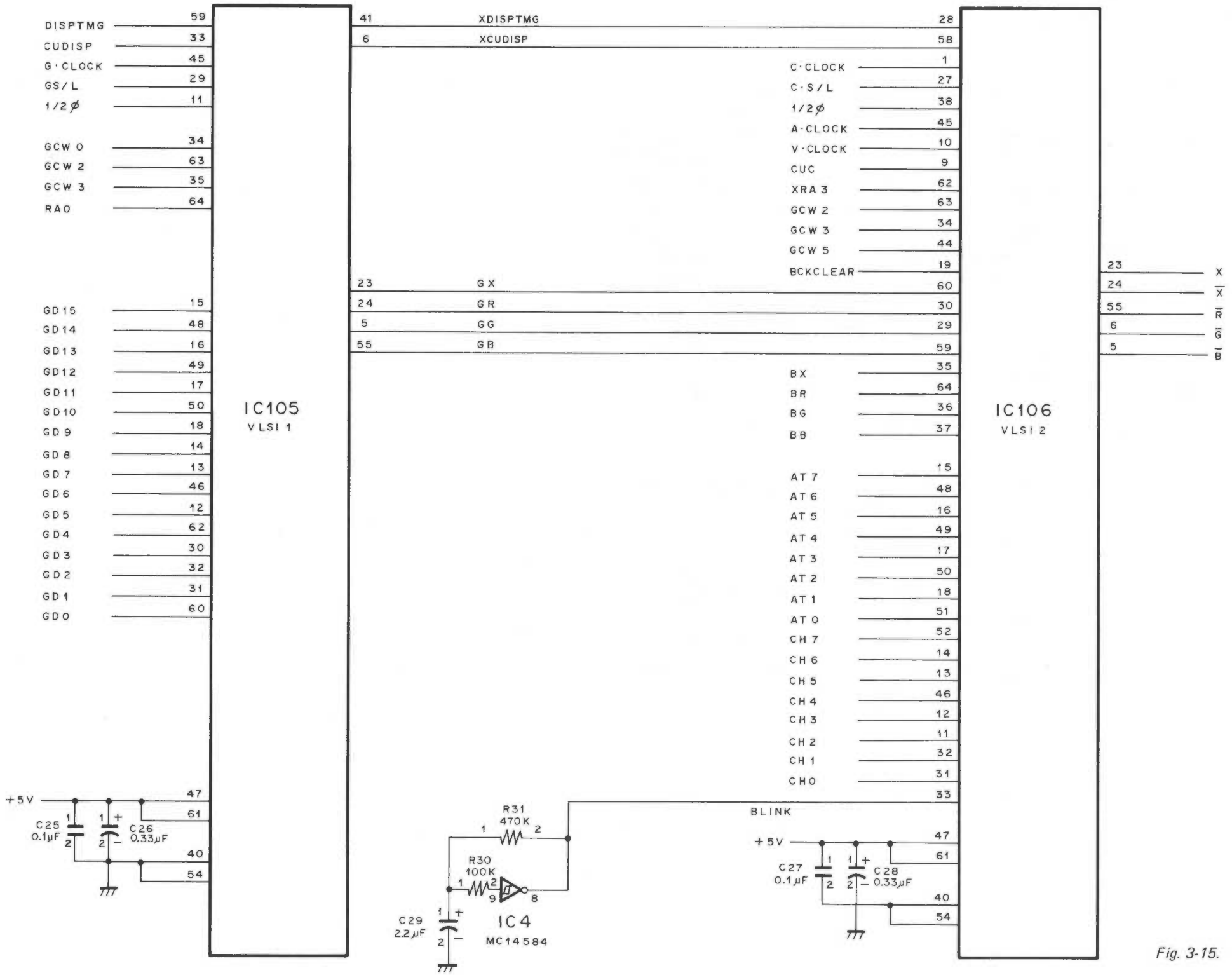
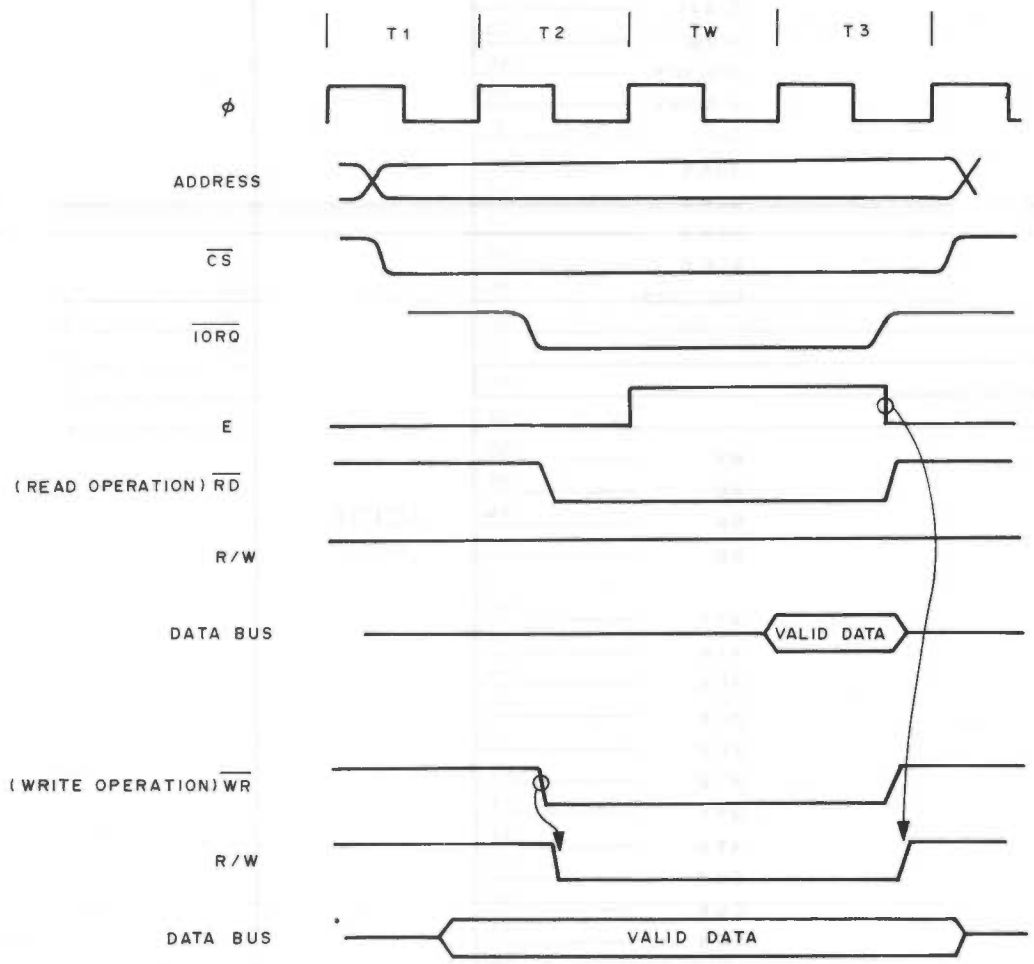


Fig. 3-15. Graphic LSIs

8. CRT Controller

The CRT controller and associated circuits are shown in Figure 3-16.

The SMC-70 uses the HD46505S CRTC as the character display controller. It produces the scan mode (non-interlace or interlace sync and video), the horizontal sync frequency (15.73kHz) and the dot frequency (16.11MHz). It also has a light pen input. Z-80 access of the CRTC is shown in Chart 3-6.



Cht. 3-6. Z-80 Access of CRTC

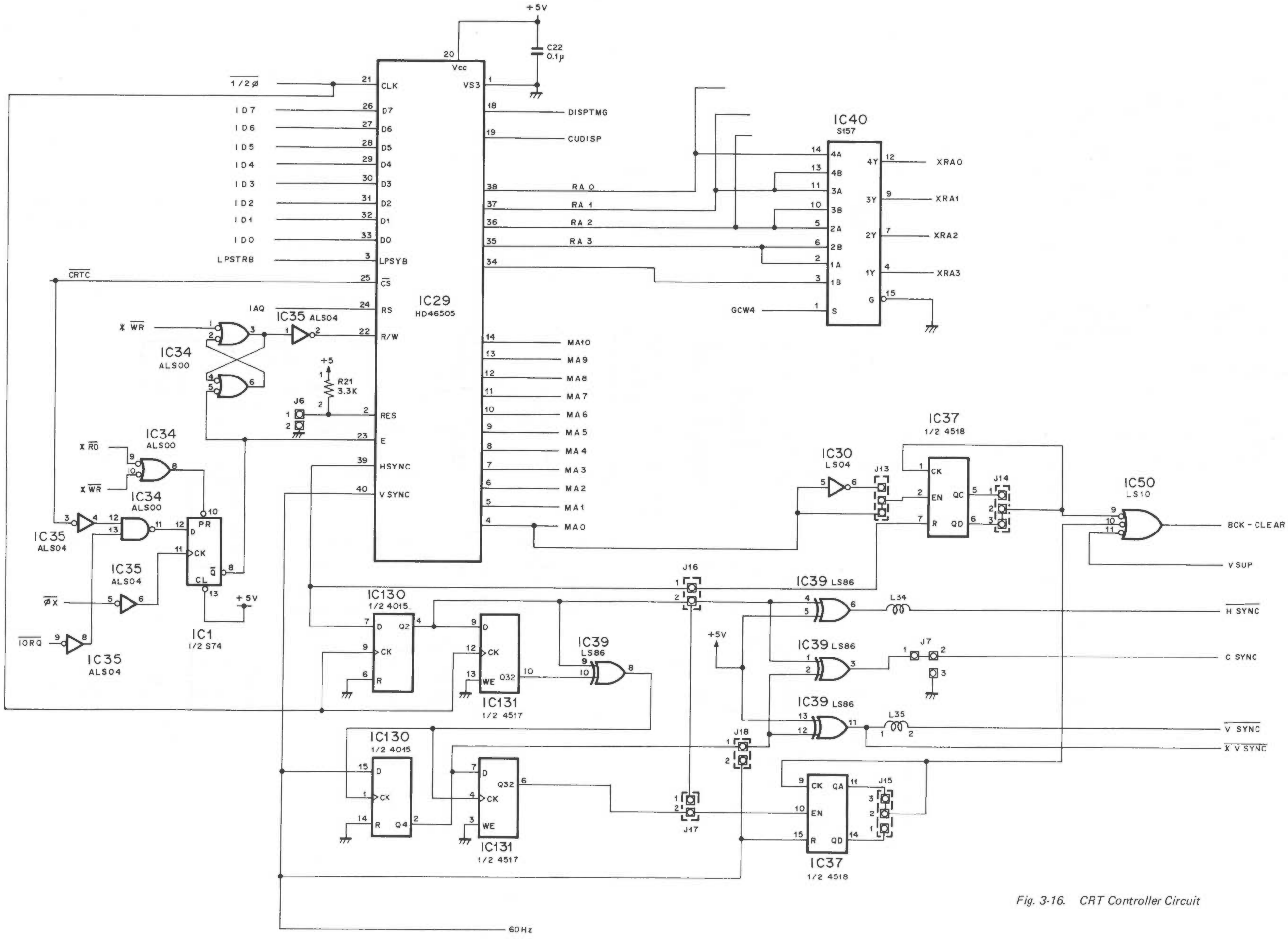


Fig. 3-16. CRT Controller Circuit

9. Video Block Overview

Figure 3-17 gives an overview of the video block.

The video section of the SMC-70 is particularly complex, and this brief description is necessarily extremely superficial just to provide some orientation. The timing relationships of the SMC-70 video RAM and CRTC timing is given in Chart 3-4 (page 3-23). From the servicing point of view, using this data to locate a single, perhaps simple, fault in a single component would obviously be difficult and time-consuming, and more specific guidance on working back from observed malfunctions to likely faulty components is given later in the manual.

Conceptually, the display can be considered as three planes. The character plane have priority over the graphic plane, while the backdrop plane have no priority over other two planes (character and graphic planes).

10. CRT Interface

The CRT interface circuit takes as its input the X, $\overline{X}$, $\overline{R}$, $\overline{G}$, $\overline{B}$, and C.SYNC signals. For the black and white output, these signals (except X) are added resistively and are output by emitter follower transistor Q5, whereas the color signals are output separately.

3-4. I/O BUS DRIVER

Figure 3-18 shows the I/O bus driver circuit.

$\overline{RD}$, $\overline{WR}$, $\overline{IORQ}$, and address lines $A_0 - A_{15}$ are all supplied to 74LS367 non-inverting bus drivers, while the data lines $D_0 - D_7$ are buffered by a 74LS245 bi-directional octal bus transceiver (with pull-ups on the external side). These buffers are exposed to possible misuse, noise etc and are consequently more likely to be damaged than other components. If optional I/O devices fail to work, these buffers should be checked. They are socketed to facilitate replacement.

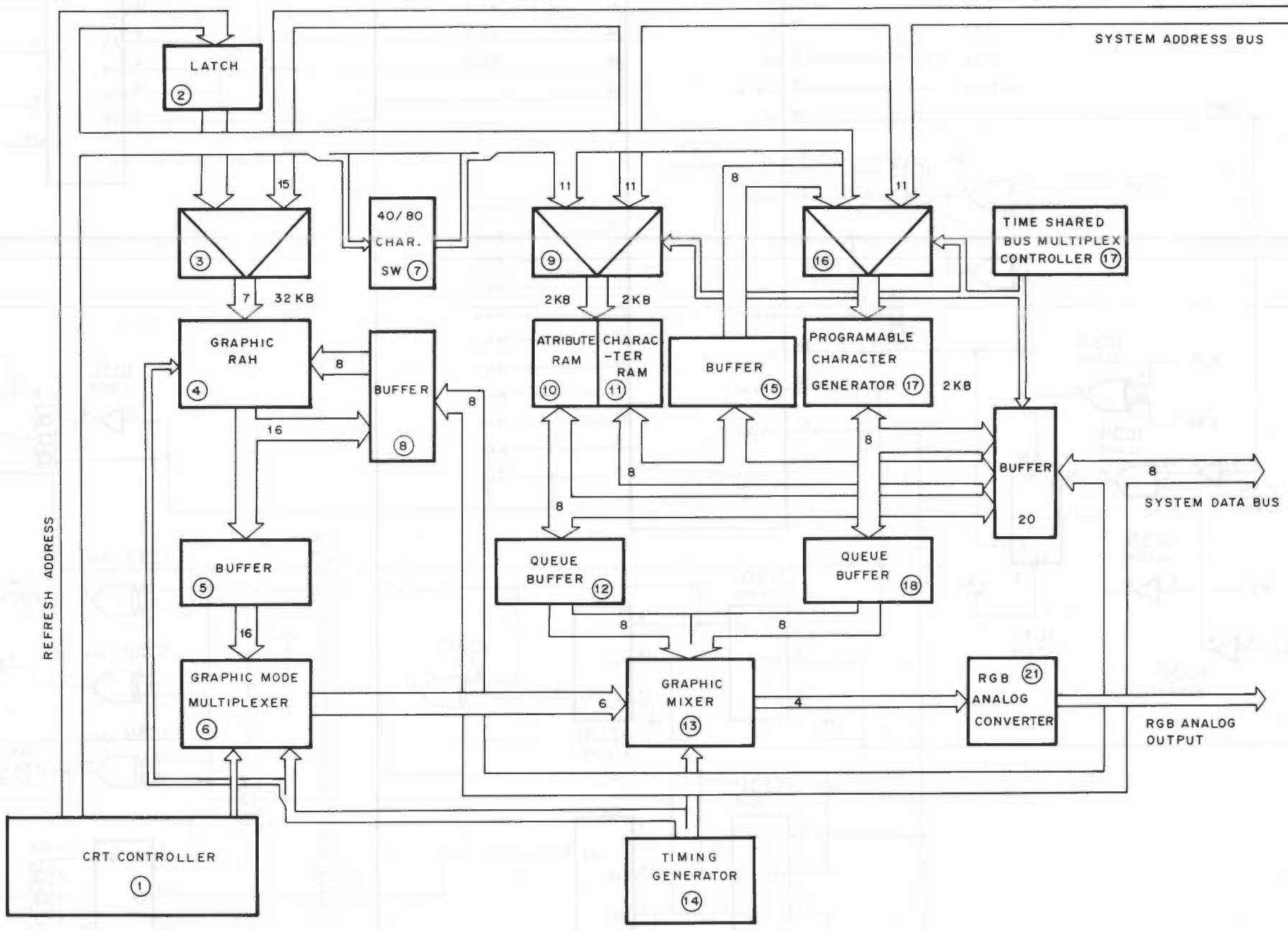


Fig. 3-17. Video Circuit Overview

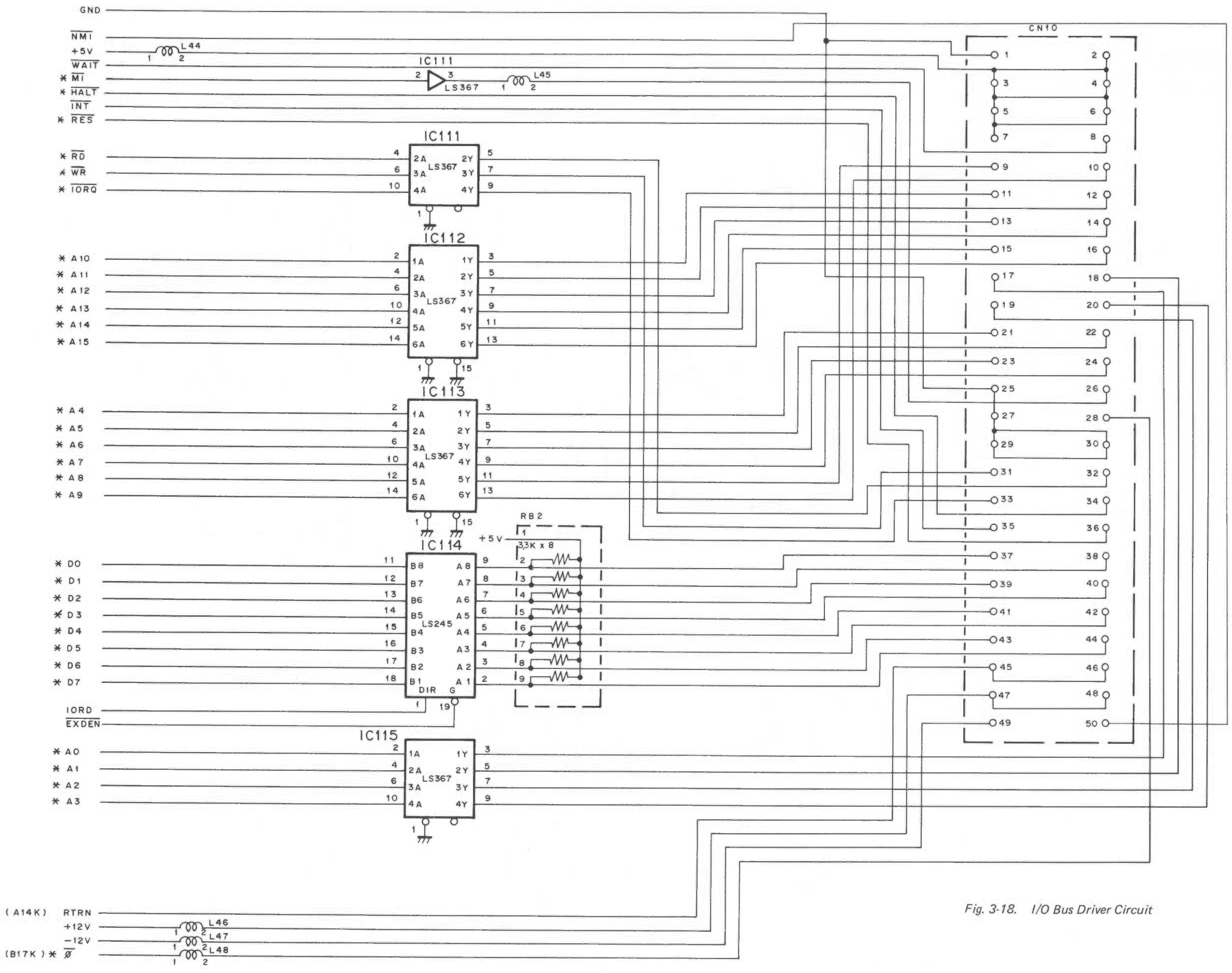


Fig. 3-18. I/O Bus Driver Circuit

3-5. I/O PORT ADDRESS DECODING

The I/O ports are decoded as shown in Figure 3-19 and the I/O map is given in Table 3-3.

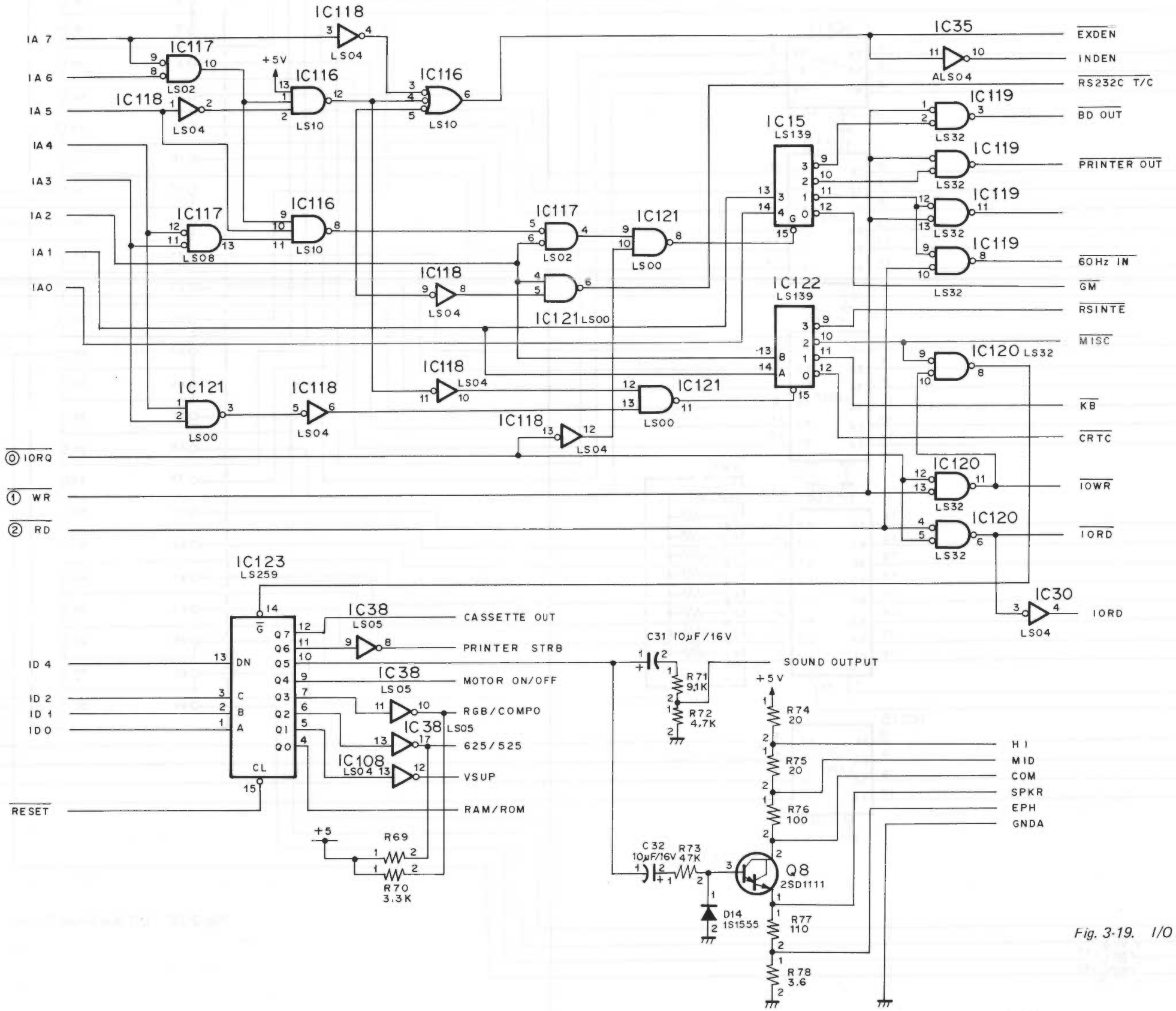


Fig. 3-19. I/O Port Address Decoding

Internal Interface I/O
I/O Port Assignment

		Port Address	Notes
Display control	Character RAM	00H 07H	Upper byte of port address is specified by the C register and the lower byte is specified by the B register.
	Attribute RAM	08H 0FH	
	PCG	10H 17H	
	Graphic RAM	80H FFH	
	CRT Controller	18H 19H	Specifies int. register address Data buffer to int. register
	Display mode switching	20H	See Table 1 for details.
	Border area control	23H	Only lower 4 bits effective
Keyboard	Keyboard data	1AH	
	Keyboard status	1BH	Repeat time, function key definition and interrupt control possible
Printer	Printer output data	22H	
	Printer strobe	1CH/1DH	See Table 2 for details.
	Printer status	1DH	
RS-232C	Send/Receive Data	26H	
	Mode/Command/Status	27H	
	Interrupt control	1EH/1FH	
Timer	Write/Specify address	24H	
	Read	25H	
Other	60Hz interrupt control	21H	
	Various status and control data	1CH 1DH	See Table 2 for details.

Tab. 3-3. I/O Map (1/2)

External Interface I/O

I/O Device		Port Address
Floppy disk control	No.1	30H – 34H
	No. 2	28H – 2CH
RS-232C	No.2	2DH – 2FH
	No.3	35H – 37H
Cache disk unit		38H – 3BH
RGB Superimposer		3CH – 3DH
IEEE-488 interface unit		40H – 47H
Hard disk unit		48H – 50H
VTR Controller		54H – 59H
ROM Packs	Auto start ROM	70H
	IEEE-488 ROM	74H
	VTR Cont. ROM	75H
	Other	71H – 73H 77H – 7FH
RAM Banking		5AH – 5BH
Unused area		5CH – 6FH

Tab. 3-3. I/O Map (2/2)

3-6. RS232C INTERFACE

The RS232C interface is mounted on the sub-board and the circuit is shown in Figure 3-20. The data lines are buffered by the 3-state 74LS245 octal bus transceiver (IC204) and the data conversion is done in a P8251A (IC205). Terminal/modem switching is done in hardware by switch SW2.
The P8251A is configured under program control to transmit and receive serial data according to several different protocols. Programming of the P8251A is dealt with fully in the P8251A User's Manual. Conversion from TTL to RS232C specified levels and vice versa is performed by IC208 and IC209 (SN75188, SN75189A) respectively. These ICs are socketed, as is the P8251A.

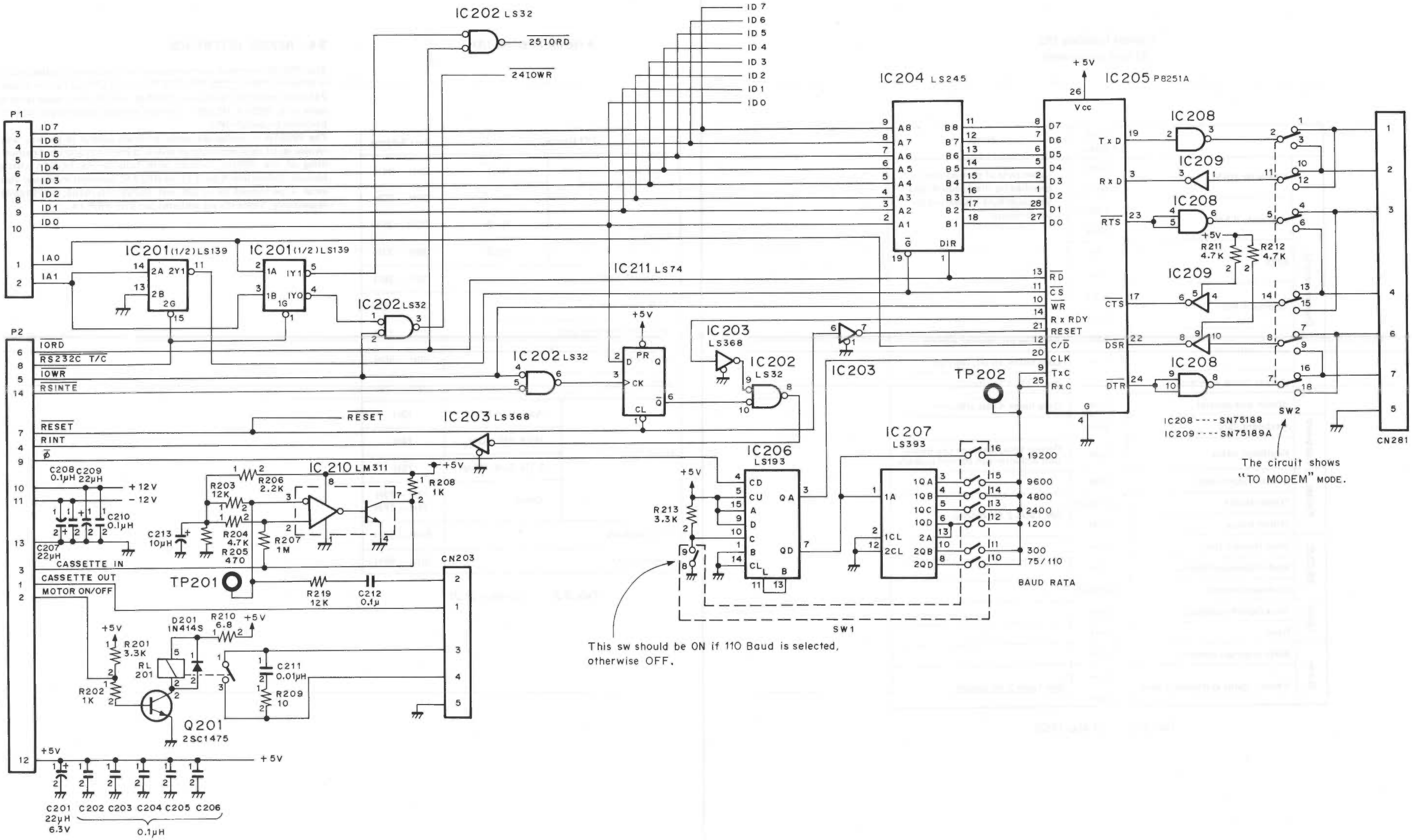


Fig. 3-20. RS232C Interface

3-7. KEYBOARD

The keyboard circuit of the SMC-70 is shown in Figure 3-21. It incorporates a dedicated 8-bit M5L8041A microprocessor (IC1) which handles the scanning and general keyboard house-keeping. The four port bits, $P2_0$ – $P2_3$ are input to a 74LS145 BCD-to-decimal decoder/driver.

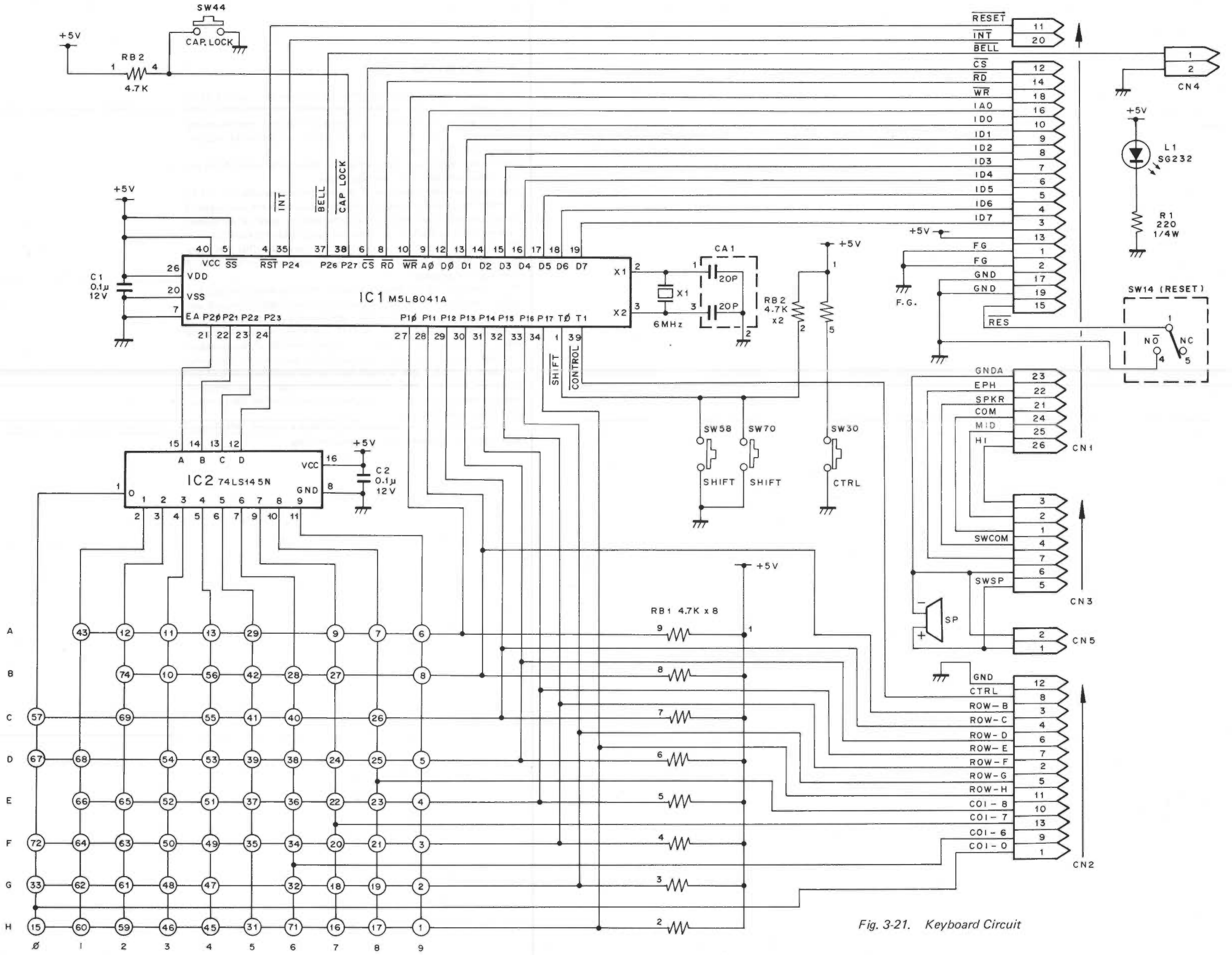
These four inputs are decoded to 10 output lines which form the columns connected to the keyboard keys.

The eight rows are pulled up to 5V and are scanned by $P1_0$ – $P1_7$ so that the processor is able to know at any moment which key is being pressed. Decoding of the row/column data is performed internally by the ROM to generate the ASCII code for the CPU.

$P2_4$ functions as an interrupt output to inform the CPU that a key has been pressed. The CPU responds by examining the data lines of the keyboard processor.

Pins T_0 and T_1 on the processor are normally pulled up to 5V, but closure of SHIFT or CTRL respectively drops these to ground and the processor processes the data appropriately. Similarly, $P2_7$ is pulled down to ground when the CAP LOCK key is closed and alpha characters are output in upper case code. When $\overline{RD}$ of the processor is made low by the CPU, it outputs ASCII code on the data pins. However, if the $\overline{WR}$ pin is made low, partial reprogramming of the processor from the CPU becomes possible, enabling the timing of the key repeat function to be changed and allowing the function keys to be redefined.

The clock for IC1 is provided by a 6MHz crystal. IC1 is also socketed to facilitate service or reprogramming.



See page 5-51 for detail

Fig. 3-21. Keyboard Circuit

3-8. KEY-PAD INTERFACE

The Key-pad keys are simply connected in parallel with the numeric keys on the normal keyboard. Operation of the CAP LOCK key will not affect the numeric data input, but simultaneously pressing the SHIFT key and using the key-pad will cause the upper case equivalents of the numbers to be input. The circuit is shown in Figure 3-22.

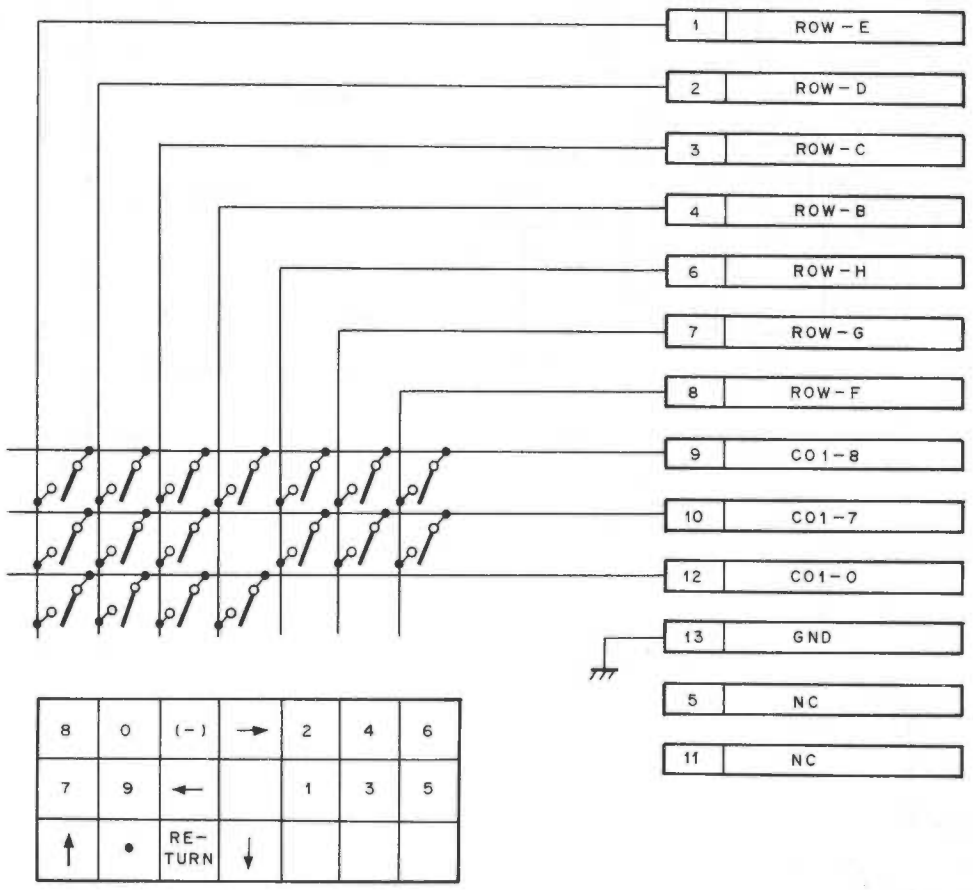


Fig. 3-22. Key-pad Circuit

3-9. SPEAKER INTERFACE

The speaker itself is located on the keyboard PCB, although the drive circuit for the speaker is provided on the main board of the SMC-70 as shown in Figure 3-23.

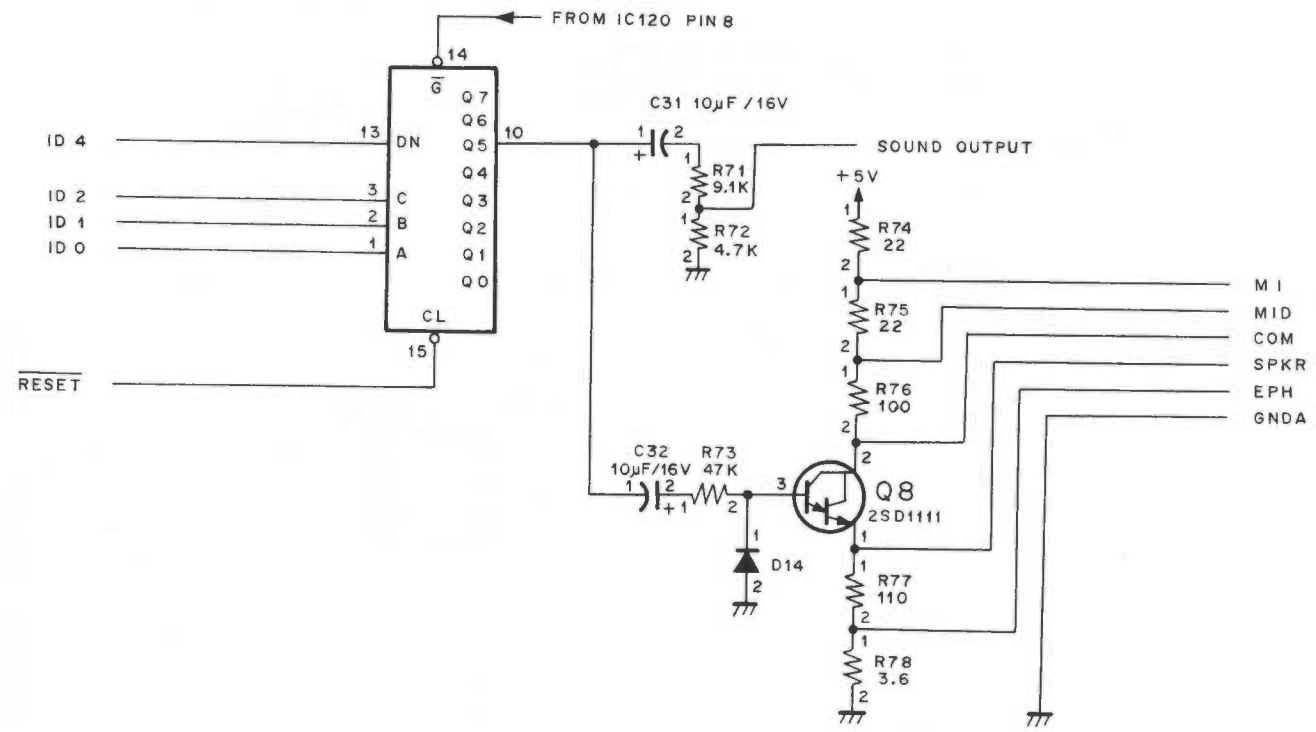


Fig. 3-23. Speaker Circuit

3-10. PRINTER INTERFACE

Figure 3-24 shows the printer interface circuit.
The printer interface is provided on the sub-board. The data lines from the CPU are buffered by IC41 (74LS374) which is an octal D-type flip-flop with 3-state bus driving outputs. This latch is clocked by the PRINTER OUT signal.
The printer signal lines on CN3 conform to the Centronics standard.

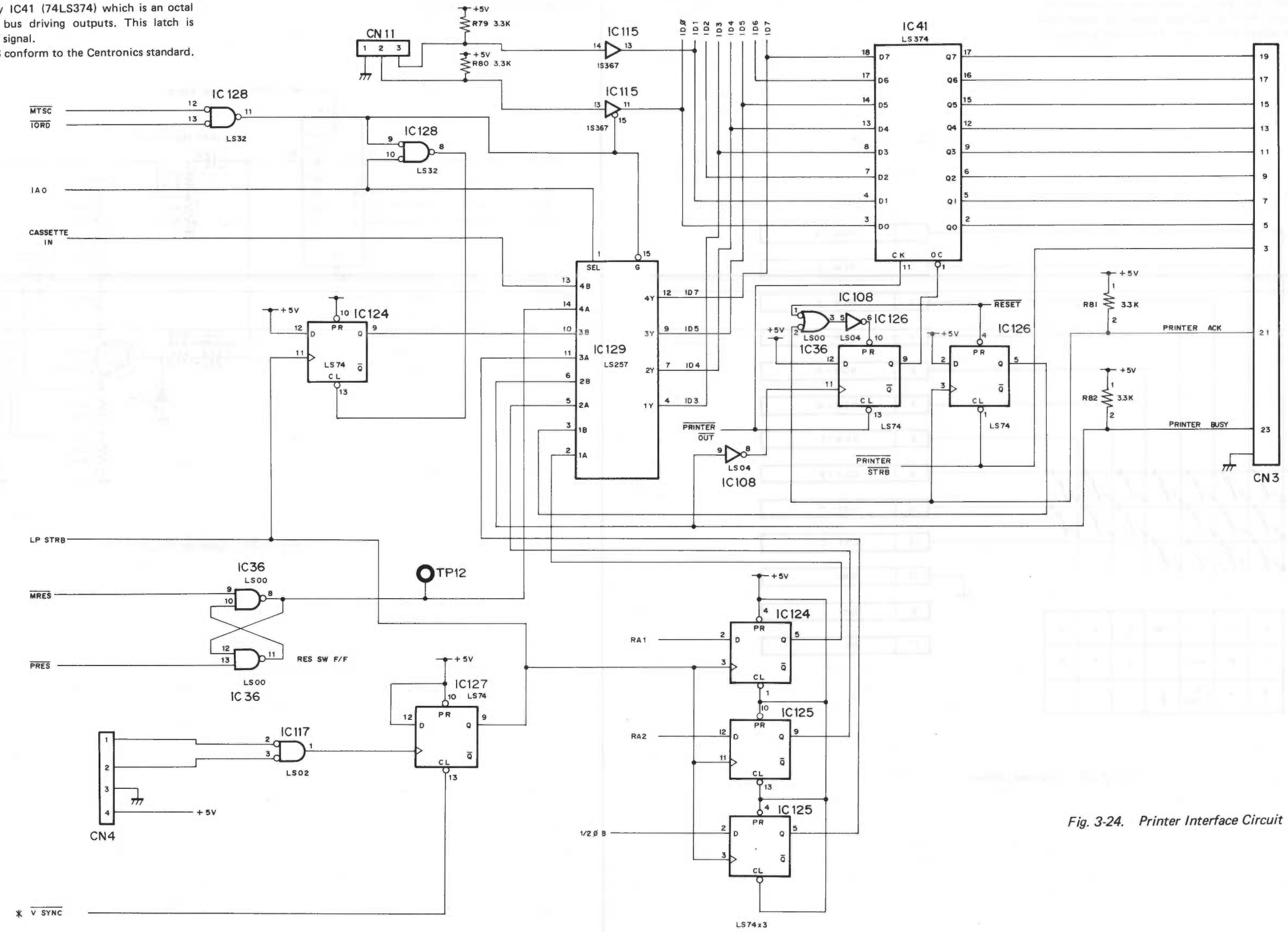


Fig. 3-24. Printer Interface Circuit

3-11. POWER SUPPLY

The power supply for the SMC-70 provides three voltages, 5V at 5A, +12V at 1.6A and −12V at 0.1A. The −12V supply is regulated by a conventional 3-terminal regulator, while the +12V supply is unregulated. A switching regulator is used for the 5V supply. The circuit is given in Figure 3-25.

The incoming AC is filtered by C1, L1, C2 & C3 and L2, C4, C5 & C6. This is then rectified by D1. The output of D1 supplies series regulator transistor Q2. Together with Q3 which functions as a switcher to supply voltage to the integrated switching regulator circuit HIC1. This device produces an oscillating output fed to transformer T1 to produce the switching frequency for the main switching transistor Q1 which switches the primary of transformer T2 at a frequency of approximately 100kHz. The thyristor provided in the primary of transformer T2 is off when power is first applied and current is routed through the fuse F2 and resistor R1 and enters transformer T2. R1 is a 15 ohm resistors that limits the power on rush current. Shortly after, the thyristor turns on and allows the current to flow through it, bypassing the fuse and resistor and flowing directly into the transformer.

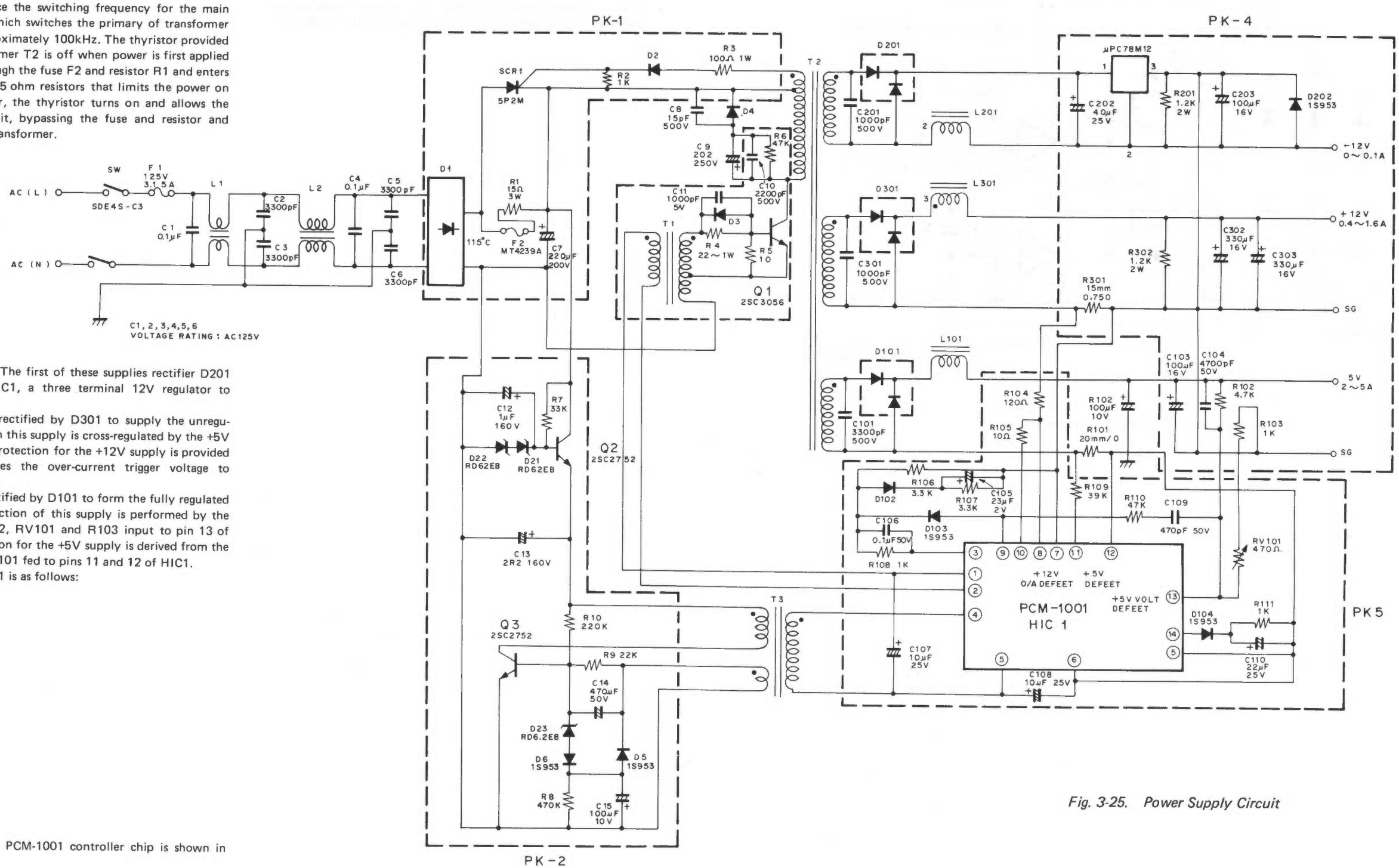


Fig. 3-25. Power Supply Circuit

T2 has three secondaries. The first of these supplies rectifier D201 which in turn supplies IC1, a three terminal 12V regulator to provide the −12V supply.

The second secondary is rectified by D301 to supply the unregulated +12 supply (although this supply is cross-regulated by the +5V regulation). Overcurrent protection for the +12V supply is provided by R301 which produces the over-current trigger voltage to terminals 7 and 8 of HIC1.

The third secondary is rectified by D101 to form the fully regulated +5V supply. Voltage detection of this supply is performed by the voltage divider chain R102, RV101 and R103 input to pin 13 of HIC1. Over-current detection for the +5V supply is derived from the voltage developed across R101 fed to pins 11 and 12 of HIC1.

The pin assignment of HIC1 is as follows:

1. V_{CC}
2. C_{DT}
3. SHUT DOWN 2
4. PT1
5. PT2
6. CH1
7. CL2+
8. CL2−
9. SHUT DOWN 1
10. V_{REF}
11. CL1−
12. CL1+
13. F.B.
14. CH2
15. GND
16. not connected

The internal circuit of the PCM-1001 controller chip is shown in Figure 3-26.

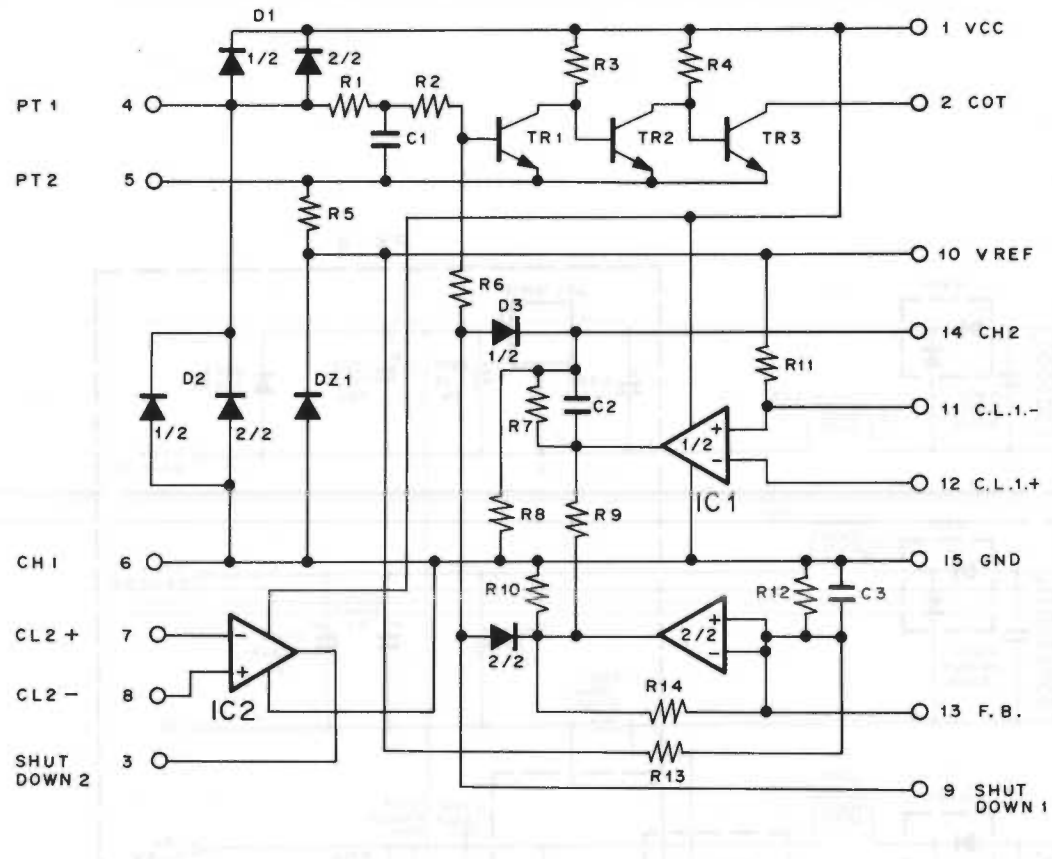
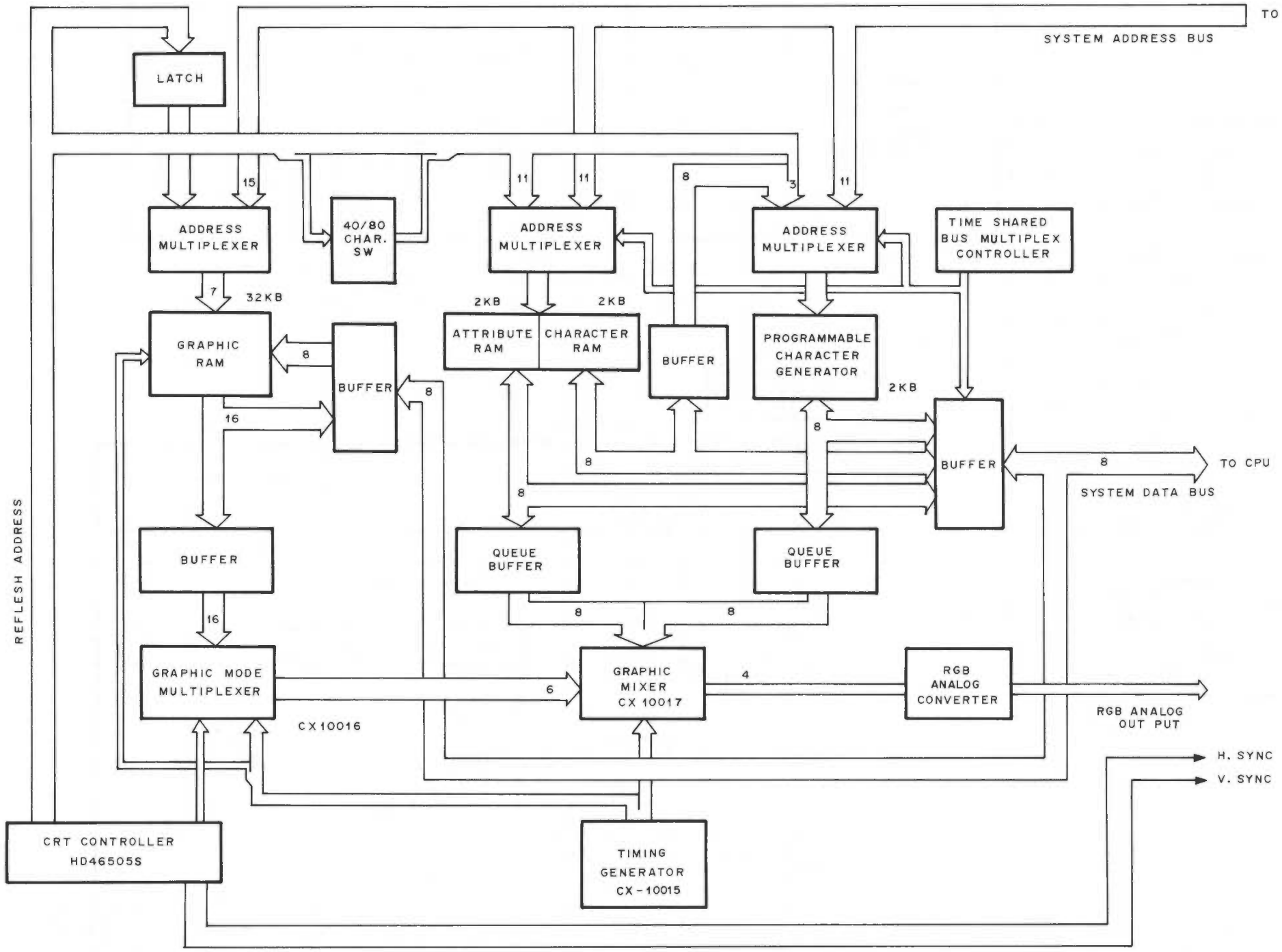


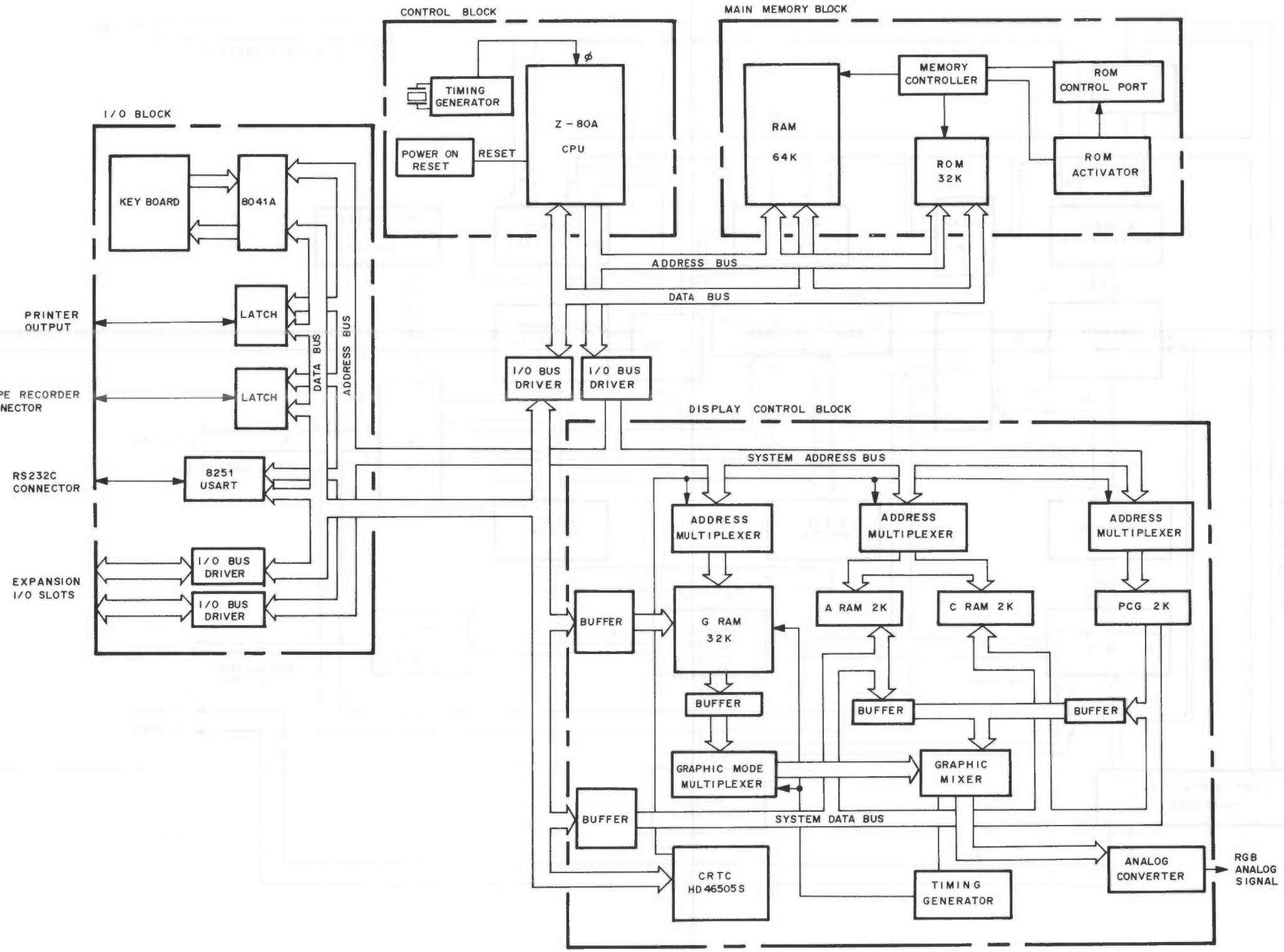
Fig. 3-26. PCM-1001 Controller

3-12. EXPANSION BUS

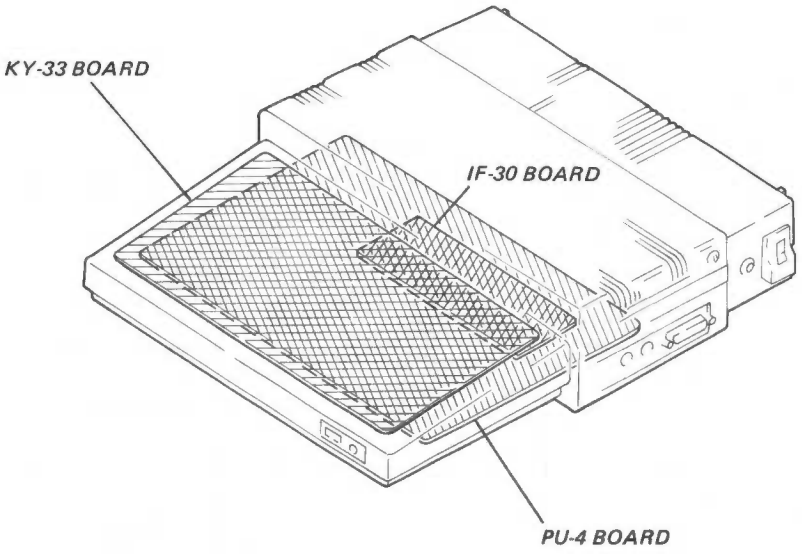
The SMC-70 is equipped with an expansion bus to which the optional accessory units such as the SMI-7012 micro floppydisk drives or the SMI-7032 GPIB interface are directly connected. The expansion bus is shown in Figure 3-18 (page 3-43). The main status and control signals from the Z-80A, together with address lines A_0 – A_{15} and data lines D_0 – D_7 are brought out to connector CN10. The address lines are buffered by 74LS367s, as are lines $\overline{M1}$, $\overline{RD}$, $\overline{WR}$ and $\overline{IORQ}$. The data lines are buffered by a 74LS245 octal bidirectional bus driver/receiver. Pull-ups are provided on the external side of the data buffer. All of these buffers are socketed as there is a greater danger of damage due to static, noise or user misuse. Other lines include +5V, +12V, –12V, RTRN, GND and ϕ.


TO CPU
SYSTEM ADDRESS BUS
LATCH
15
11
11
8
3
11
ADDRESS MULTIPLEXER
40/80 CHAR. SW
ADDRESS MULTIPLEXER
ADDRESS MULTIPLEXER
TIME SHARED BUS MULTIPLEX CONTROLLER
7
32KB
2KB
2KB
GRAPHIC RAM
8
BUFFER
8
ATTRIBUTE RAM
CHARACTER RAM
BUFFER
PROGRAMMABLE CHARACTER GENERATOR
2KB
16
8
BUFFER
8
TO CPU
SYSTEM DATA BUS
8
8
BUFFER
QUEUE BUFFER
QUEUE BUFFER
16
8
8
REFLESH ADDRESS
GRAPHIC MODE MULTIPLEXER
6
CX10016
GRAPHIC MIXER CX 10017
4
RGB ANALOG CONVERTER
RGB ANALOG OUT PUT
H. SYNC
V. SYNC
CRT CONTROLLER HD46505S
TIMING GENERATOR CX-10015

SECTION 4
BLOCK DIAGRAM



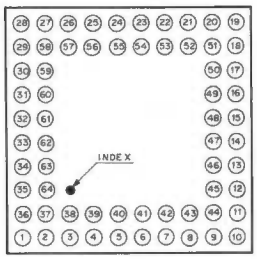
SECTION 5
PRINTED CIRCUIT BOARD AND SCHEMATIC DIAGRAM



Note: The blue pattern on board layout is COMPONENT SIDE.
The gray pattern on board layout is SOLDERING SIDE.

SEMICONDUCTOR ELECTRODES

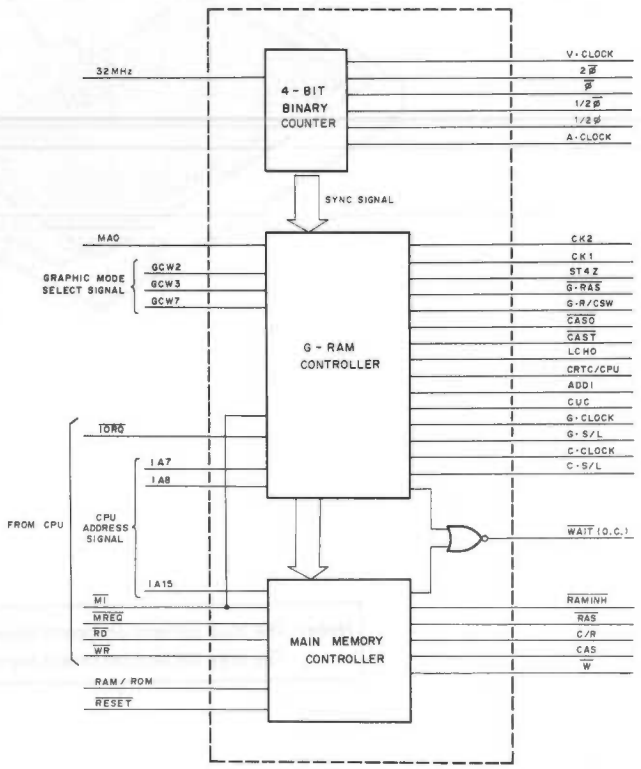
CX-10015
- TOP VIEW -



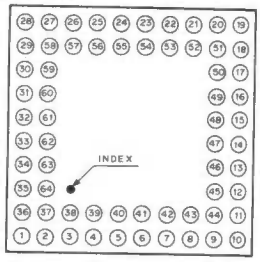
PIN NO.	I/O PIN NAME	PIN NAME	PIN TYPE	PIN NO.	I/O PIN NAME	PIN NAME	PIN TYPE
1	—			33	I 10	IA 15	I 81
2	O 06	1/2$\overline{\phi}$	O 91	34	I 15	$\overline{RES}$	I 81
3	O 07	1/2ϕ	O 91	35	—		
4	O 01	V·CLOCK	O 96	36	O 19	G·CLOCK	O 91
5	O 02	2$\overline{\phi}$	O 96	37	—		
6	O 03	$\overline{\phi}$	O 96	38	O 12	LCHO	O 91
7	O 04	$\overline{\phi X}$	O 96	39	O 25	$\overline{RAM\ INH}$	O 91
8	O 27	C/R	O 91	40		GND	
9	O 26	$\overline{RAS}$	O 91	41	O 05	$\overline{\phi Y}$	O 91
10	—			42	O 28	CAS	O 91
11	—			43	O 29	$\overline{W}$	O 91
12	I 06	$\overline{IORQ}$	I 81	44	—		
13	I 08	GCW3	I 81	45	—		
14	I 02	$\overline{T\ RESET}$	I 81	46	I 01	32M	I 81
15	I 07	GCW2	I 81	47		Vcc	
16	I 12	$\overline{M\ REQ}$	I 81	48	I 05	IA8	I 81
17	—			49	I 11	$\overline{MI}$	I 81
18	O 09	CK2	O 91	50	—		
19	—			51	—		
20	O 17	$\overline{CAS1}$	O 91	52	O 16	$\overline{CAS0}$	O 91
21	O 18	ADD1	O 91	53	O 10	ST4Z	O 91
22	O 11	CK1	O 91	54		GND	
23	O 14	$\overline{G\ RAS}$	O 91	55	O 15	G·R/C·SW	O 91
24	O 20	G·S/L	O 91	56	O 13	ORTC/CPU	O 91
25	O 22	C·S/L	O 91	57	O 23	CUC	O 91
26	O 21	C·CLOCK	O 91	58	—		
27	O 24	$\overline{WAIT}$	O 91	59	O 08	A·CLOCK	O 91
28	—			60	I 04	IA7	I 81
29	—			61		Vcc	
30	I 03	MAO	I 81	62	I 14	$\overline{WR}$	I 81
31	I 13	$\overline{RD}$	I 81	63	I 16	RAM/ROM	I 81
32	I 09	GCW7	I 81	64	—		

* PIN TYPE
- 81 ; NORMALLY INPUT GATE
- 82 ; WITH PULL UP REGISTER
- 91 ; TOTEM POLE OUTPUT
- 92 ; THREE-STATE OUTPUT
- 93 ; BIDIRECTIONAL TYPE
- 94 ; OPEN COLLECTOR OUTPUT

BLOCK DIAGRAM



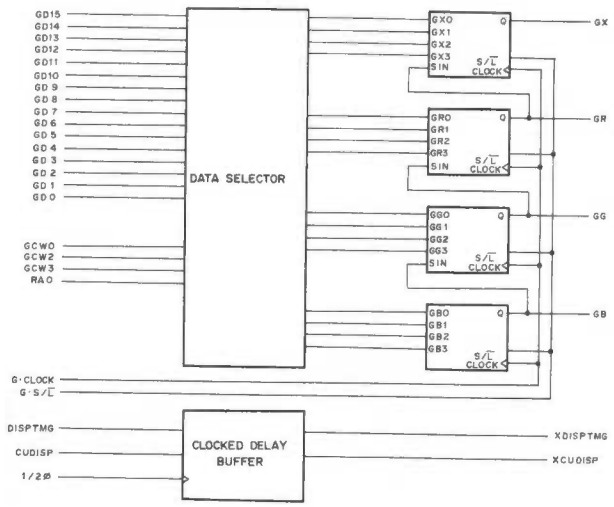
CX-10016
LSI GRAPHIC MODE MULTIPLEXER
– TOP VIEW–



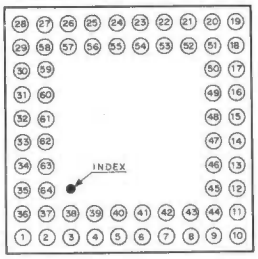
PIN NO.	I/O PIN NAME	PIN NAME	PIN TYPE	PIN NO.	I/O PIN NAME	PIN NAME	PIN TYPE
1	—			33	I 20	CUDISP	I 81
2	—			34	I 22	GCW0	I 81
3	—			35	I 24	GCW2	I 81
4	—			36	—		
5	003	GG	091	37	—		
6	006	XCU DISP	091	38	—		
7	—			39	—		
8	—			40	GND		
9	—			41	005	X DISP TMG	091
10	—			42	—		
11	I 21	1/2Ø	I 81	43	—		
12	I 11	GD5	I 81	44	—		
13	I 09	GD7	I 81	45	I 17	G·CLOCK	I 81
14	I 08	GD8	I 81	46	I 10	GD6	I 81
15	I 01	GD15	I 81	47	Vcc		
16	I 03	GD13	I 81	48	I 02	GD14	I 81
17	I 05	GD11	I 81	49	I 04	GD12	I 81
18	I 07	GD9	I 81	50	I 06	GD10	I 81
19	—			51	—		
20	—			52	—		
21	—			53	—		
22	—			54	GND		
23	001	GX	091	55	004	GB	091
24	002	GR	091	56	—		
25	—			57	—		
26	—			58	—		
27	—			59	I 19	DISP TMG	I 81
28	—			60	I 16	GD0	I 81
29	I 18	G·S/$\overline{L}$	I 81	61	Vcc		
30	I 13	GD3	I 81	62	I 12	GD4	I 81
31	I 15	GD1	I 81	63	I 23	GCW2	I 81
32	I 14	GD2	I 81	64	I 25	RA0	I 81

* PIN TYPE
81; NORMALLY INPUT GATE
82; PROVIDED WITH PULL-UP RESISTOR
91; TOTEM POLE OUTPUT
92; THREE-STATE OUTPUT
93; BIDIRECTIONAL TYPE
94; OPEN COLLECTOR OUTPUT

BLOCK DIAGRAM



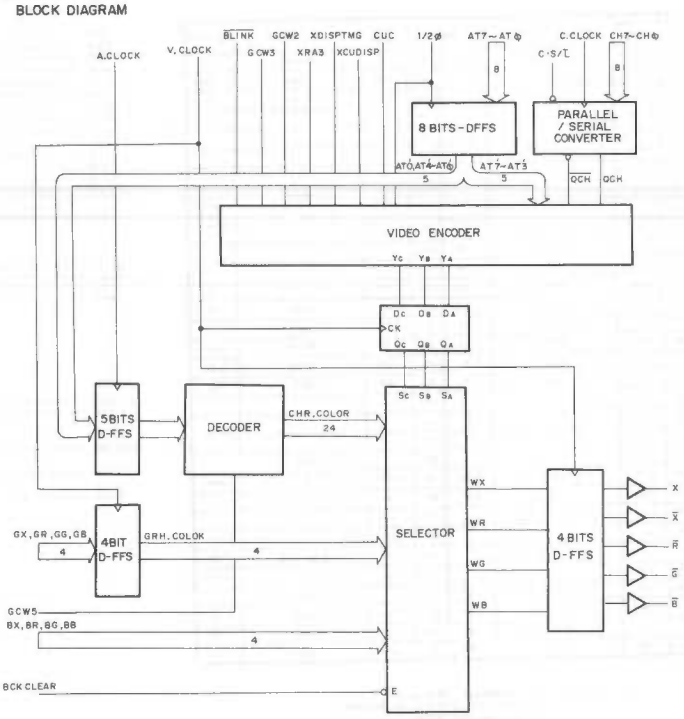
CX-10017
LSI GRAPHIC MIXER
-TOP VIEW-



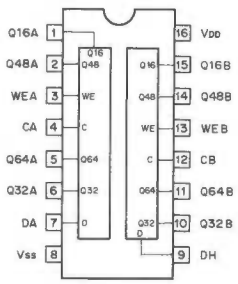
PIN NO.	I/O PIN NAME	PIN NAME	PIN TYPE	PIN NO.	I/O PIN NAME	PIN NAME	PIN TYPE
1	I 18	O. CLOCK	I 81	33	I 29	BLINK	I 81
2	—			34	I 31	GCW3	I 81
3	—			35	I 33	BX	I 81
4	—			36	I 35	BG	I 81
5	O 05	$\overline{B}$	O 91	37	I 36	BB	I 81
6	O 04	$\overline{G}$	O 91	38	I 09	1/2 ø	I 81
7	—			39	—		
8	—			40		GND	
9	I 28	CUC	I 81	41	—		
10	I 21	V. CLOCK	I 81	42	—		
11	I 15	CH2	I 81	43	—		
12	I 14	CH3	I 81	44	I 37	GCW5	I 81
13	I 12	CH5	I 81	45	I 20	A. CLOCK	I 81
14	I 11	CH6	I 81	46	I 13	CH4	I 81
15	I 01	ATD 7	I 81	47		Vcc	
16	I 03	ATD 5	I 81	48	I 02	ATD 6	I 81
17	I 05	ATD 3	I 81	49	I 04	ATD 4	I 81
18	I 07	ATD 1	I 81	50	I 06	ATD 2	I 81
19	I 38	BCK CLEAR	I 81	51	I 08	ATD 0	I 81
20	—			52	I 10	CH7	I 81
21	—			53	—		
22	—			54		GND	
23	O 01	X	O 91	55	O 03	R	O 91
24	O 02	$\overline{X}$	O 91	56	—		
25	—			57	—		
26	—			58	I 27	X CU DISP	I 81
27	I 19	C. S/$\overline{L}$	I 81	59	I 25	GB	I 81
28	I 26	X DISP TMG	I 81	60	I 22	GX	I 81
29	I 24	GG	I 81	61		Vcc	
30	I 23	GR	I 81	62	I 30	X RA3	I 81
31	I 17	CH0	I 81	63	I 32	GCW2	I 81
32	I 16	CH1	I 81	64	I 34	BR	I 81

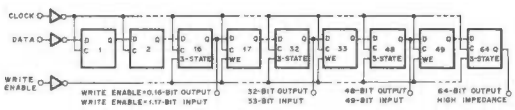
※ PIN TYPE
81; NORMALLY INPUT GATE
82; WITH PULL UP REGISTER
91; TOTEM POLE OUTPUT
92; THREE-STATE OUTPUT
93; BIDIRECTIONAL TYPE
94; OPEN COLLECTOR OUTPUT

BLOCK DIAGRAM



HD14517B
DUAL 64-BIT STATIC SHIFT REG/STER
-TOP VIEW-



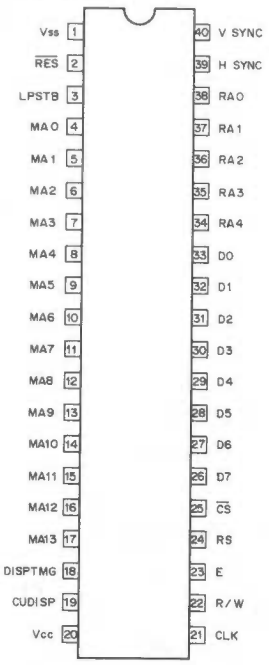


■ TRUTH TABLE

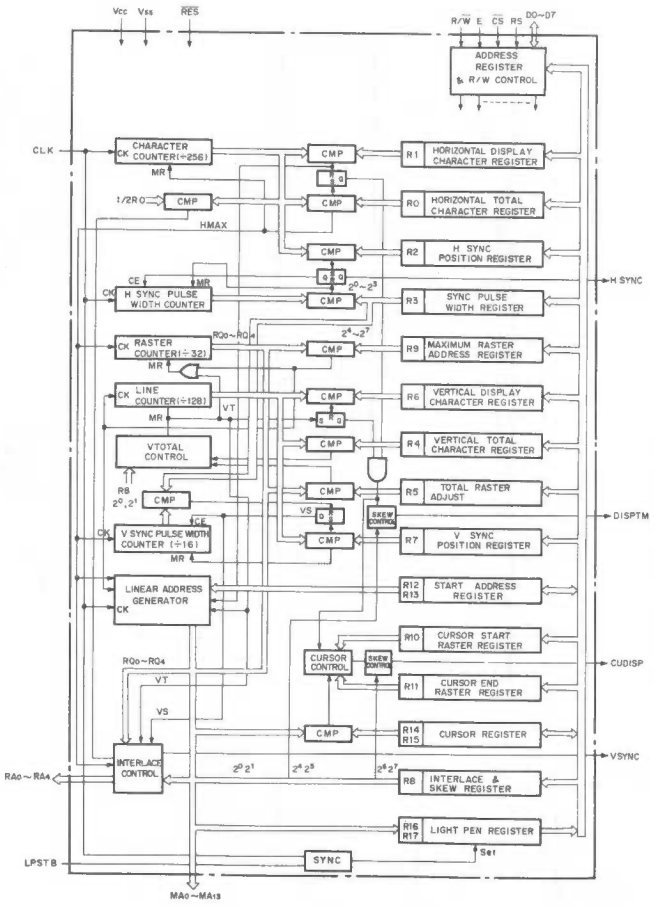
CLOCK	WRITE ENABLE	DATA	16-BIT TAP	32-BIT TAP	48-BIT TAP	64-BIT TAP
0	0	X	CONTENTS OF 16-BIT DISPLAY	CONTENTS OF 32-BIT DISPLAY	CONTENTS OF 48-BIT DISPLAY	CONTENTS OF 64-BIT DISPLAY
0	1	X	HIGH IMPEDANCE	HIGH IMPEDANCE	HIGH IMPEDANCE	HIGH IMPEDANCE
1	0	X	CONTENTS OF 16-BIT DISPLAY	CONTENTS OF 32-BIT DISPLAY	CONTENTS OF 48-BIT DISPLAY	CONTENTS OF 64-BIT DISPLAY
1	1	X	HIGH IMPEDANCE	HIGH IMPEDANCE	HIGH IMPEDANCE	HIGH IMPEDANCE
↑	0	ENTERS THE FIRST BIT	CONTENTS OF 16-BIT DISPLAY	CONTENTS OF 32-BIT DISPLAY	CONTENTS OF 48-BIT DISPLAY	CONTENTS OF 64-BIT DISPLAY
↑	1	ENTERS THE FIRST BIT	ENTERS THE 17TH BIT	CONTENTS OF 33-BIT DISPLAY	CONTENTS OF 49-BIT DISPLAY	HIGH IMPEDANCE
↓	0	X	CONTENTS OF 16-BIT DISPLAY	CONTENTS OF 32-BIT DISPLAY	CONTENTS OF 48-BIT DISPLAY	CONTENTS OF 64-BIT DISPLAY
↓	1	X	HIGH IMPEDANCE	HIGH IMPEDANCE	HIGH IMPEDANCE	HIGH IMPEDANCE

X : INDICATES EITHER 1 OR 0

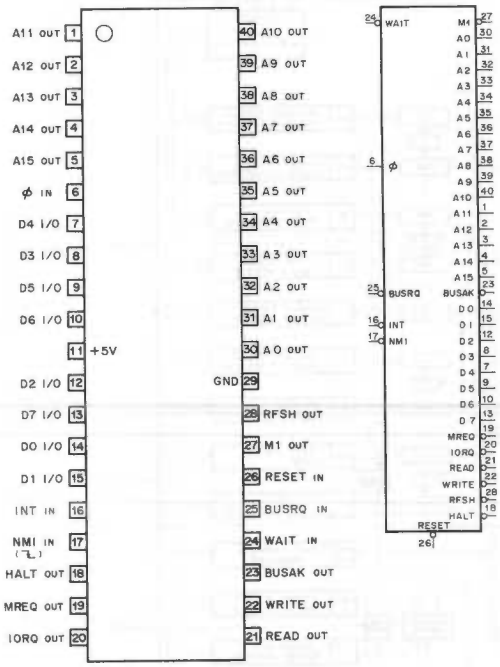
HD46505S-1
CRT CONTROLLER
– TOP VIEW –



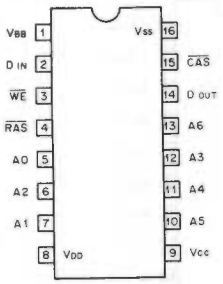
BLOCK DIAGRAM



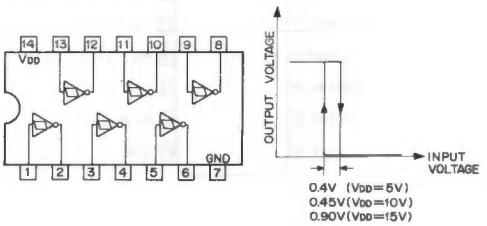
LH0080A (SHARP)
μPD780C-1(NEC)
N-MOS 8-BIT MICROPROCESSOR
— TOP VIEW —

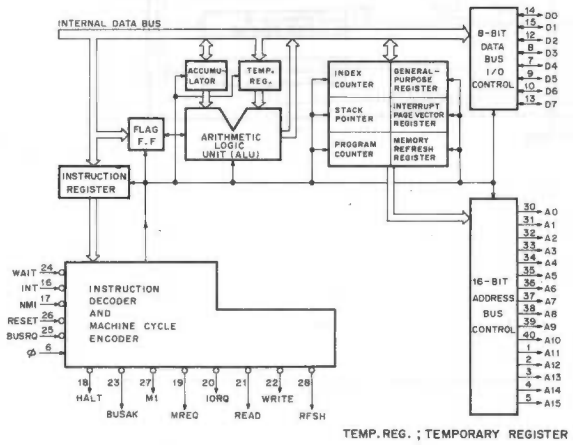


MB8116H
1638-BIT DYNAMIC RANDOM
ACCESS MEMORY
— TOP VIEW —



MC14584BCP (MOTOROLA)
HD14584BP (HITACHI)
μPD4584BC (NEC)
C-MOS SCHMITT TRIGGER INVERTER
— TOP VIEW —

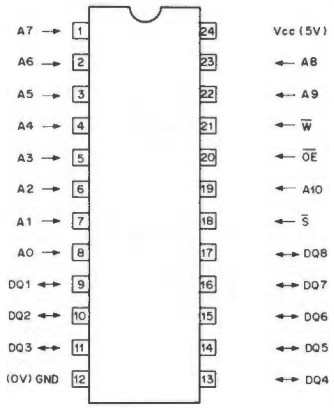




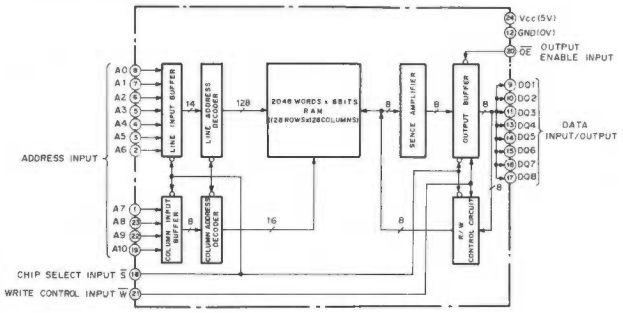
TEMP. REG. ; TEMPORARY REGISTER

φ	; CLOCK
A0-A15	; 3-STATE ADDRESS OUTPUT
BUSAK	; BUS ACKNOWLEDGE
BUSRQ	; BUS REQUEST
D0-D7	; 3-STATE DATA INPUT/OUTPUT
HALT	; HALT STATE
INT	; INTERRUPT REQUEST
IORQ	; 3-STATE I/O REQUEST
M1	; MACHINE CYCLE 1
MREQ	; 3-STATE MEMORY REQUEST
NMI	; NON-MASKABLE INTERRUPT (DOWN EDGE TRIGGER)
READ	; 3-STATE MEMORY READ
RFSH	; REFRESH
WRITE	; 3-STATE MEMORY WRITE

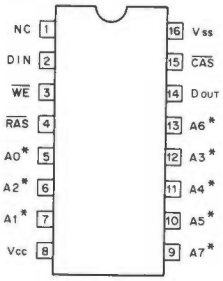
M58725P-15
16384-BIT (2048-WORD BY 8-BIT) STATIC RAM
– TOP VIEW –



BLOCK DIAGRAM

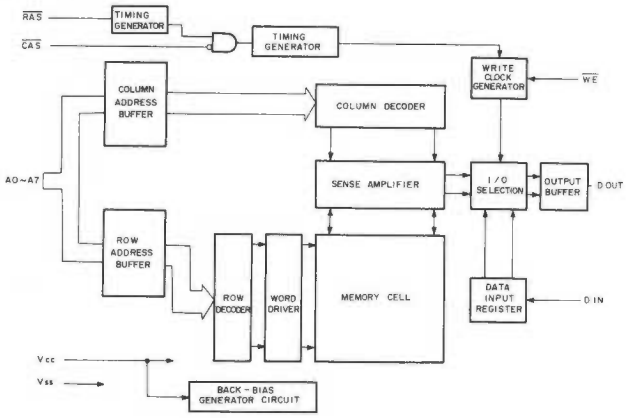


MSM3764-XXAS-RS
DYNAMIC RAM
– TOP VIEW –

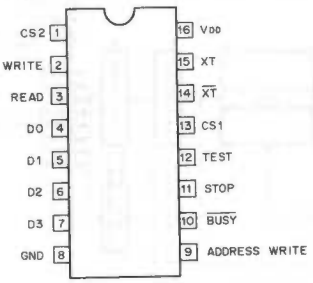


* REFRESH ADDRESS

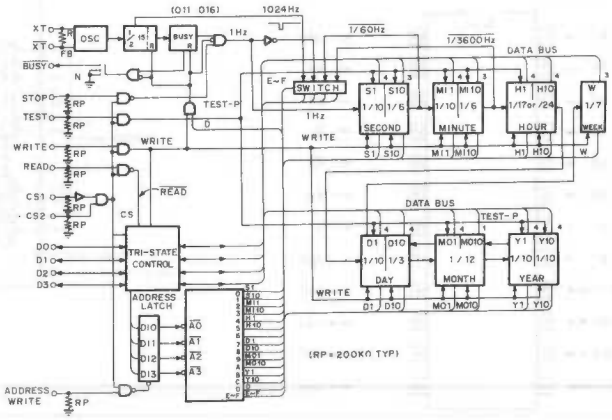
BLOCK DIAGRAM



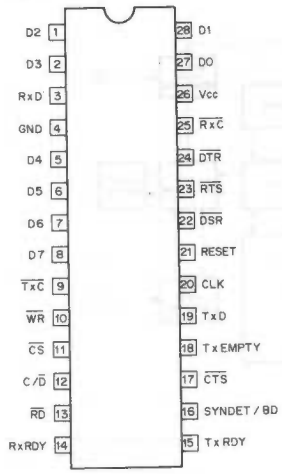
MSM58321RS
– TOP VIEW –



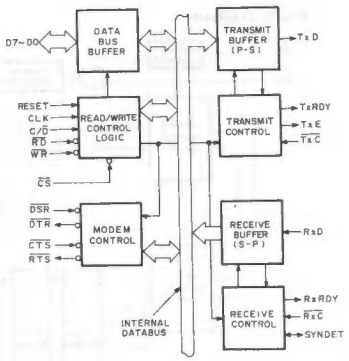
BLOCK DIAGRAM



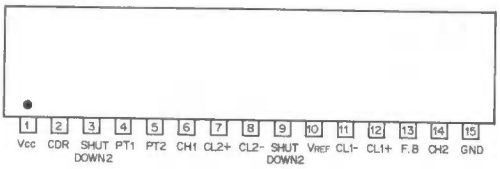
P8251A
PROGRAMMABLE COMMUNICATION INTERFACE
– TOP VIEW –



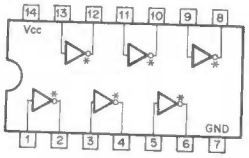
BLOCK DIAGRAM



PCM-1001
– REAR VIEW –



SN7405N (TI)
SN74LS05N (TI)
74LS05PC (FSC)
TTL INVERTER WITH OPEN-COLLECTOR
– TOP VIEW –

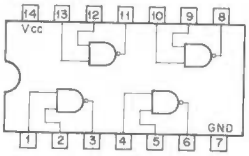


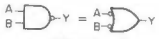
Y = $\overline{A}$

A	Y
0	1
1	0

0 : LOW LEVEL
1 : HIGH LEVEL
* : OPEN COLLECTOR

SN7400N (TI)
M53200P (MITSUBISHI)
SN74S00N (TI)
SN74LS00N (TI)
HD74LS00P (HITACHI)
SN74ALS00N (TI)
TTL NAND GATE
– TOP VIEW –



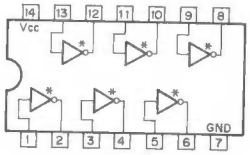


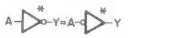
Y = $\overline{A \cdot B} = \overline{A} + \overline{B}$

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

0 ; LOW LEVEL
1 ; HIGH LEVEL

SN7406N (TI)
M53206P (MITSUBISHI)
TTL INVERTER BUFFER / DRIVER
WITH OPEN-COLLECTOR
– TOP VIEW –



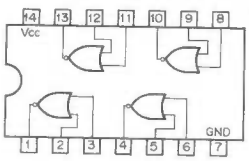


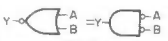
Y = $\overline{A}$

A	Y
0	1
1	0

0 ; LOW LEVEL
1 ; HIGH LEVEL
* ; OPEN COLLECTOR

SN7402N (TI)
M53202P (MITSUBISHI)
SN74S02N (TI)
SN74LS02N (TI)
HD74LS02P (HITACHI)
TTL 2-INPUT POSITIVE-NOR GATE
– TOP VIEW –



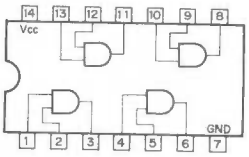


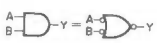
Y = $\overline{A+B} = \overline{A} \cdot \overline{B}$

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

0 : LOW LEVEL
1 : HIGH LEVEL

SN7408N (TI)
SN74S08N (TI)
SN74LS08N (TI)
HD74LS08P (HITACHI)
TTL 2-INPUT POSITIVE-AND GATE
– TOP VIEW –



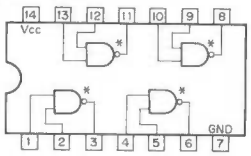


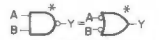
Y = $A \cdot B = \overline{\overline{A}+\overline{B}}$

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

0 ; LOW LEVEL
1 ; HIGH LEVEL

SN7403N (TI)
SN74L03N (TI)
SN74S03N (TI)
SN74LS03N (TI)
TTL 2-INPUT POSITIVE-NAND GATE
WITH OPEN-COLLECTOR
– TOP VIEW –



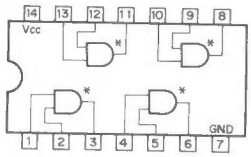


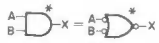
Y = $\overline{A \cdot B} = \overline{A} + \overline{B}$

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

0 ; LOW LEVEL
1 ; HIGH LEVEL

SN7409N (TI), SN74S09N (TI)
SN74LS09N (TI)
TTL 2-INPUT POSITIVE-AND GATE WITH OPEN-COLLECTOR
– TOP VIEW –

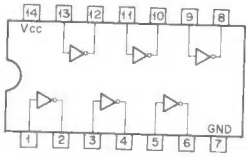


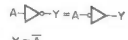


X = $A \cdot B = \overline{\overline{A}+\overline{B}}$

A	B	X
L	L	L
L	H	L
H	L	L
H	H	H

SN7404N (TI)
M53204P (MITSUBISHI)
SN74L04N (TI)
SN74S04N (TI)
SN74LS04N (TI)
HD74LS04P (HITACHI)
TTL INVERTER
– TOP VIEW –



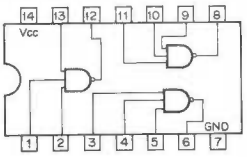


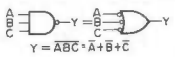
Y = $\overline{A}$

A	Y
0	1
1	0

0 ; LOW LEVEL
1 ; HIGH LEVEL

SN7410N (TI)
SN74L10N (TI)
SN74S10N (TI)
SN74LS10N (TI)
HD74LS10P (HITACHI)
TTL 3-INPUT POSITIVE NAND GATE
—TOP VIEW—

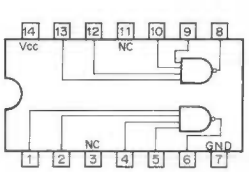


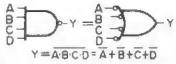


A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

0 : LOW LEVEL
1 : HIGH LEVEL

SN7420N (TI)
SN74S20N (TI)
SN74LS20N (TI)
TTL 4-INPUT POSITIVE NAND GATE
—TOP VIEW—

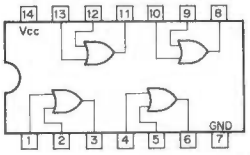


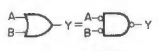


A	B	C	D	Y
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
:	:	:	:	:
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

0;LOW LEVEL
1;HIGH LEVEL

SN7432N (TI)
SN74S32N (TI)
SN74LS32N (TI)
HD74LS32P (HITACHI)
MB74LS32 (FUJITSU)
M74LS32P (MITSUBISHI)
TTL 2-INPUT POSITIVE-OR GATE
—TOP VIEW—

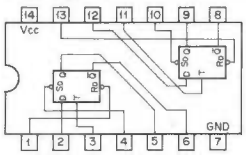




A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

0;LOW LEVEL
1;HIGH LEVEL

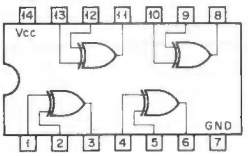
SN7474N (TI)
M53274P (MITSUBISHI)
SN74H74N (TI)
SN74L74N (TI)
SN74S74N (TI)
SN74LS74AN (TI)
HD74LS74P (HITACHI)
TTL D-TYPE FLIP FLOP WITH DIRECT SET/RESET
—TOP VIEW—



INPUTS				OUTPUTS	
$\overline{S_D}$	$\overline{R_D}$	T	D	Qn+1	$\overline{Qn+1}$
0	1	X	X	1	0
1	0	X	X	0	1
0	0	X	X	1*	1*
1	1	↑	1	1	0
1	1	↑	0	0	1
1	1	0	X	Qn	$\overline{Qn}$

0;LOW LEVEL
1;HIGH LEVEL
X;DON'T CARE
1*;NONSTABLE

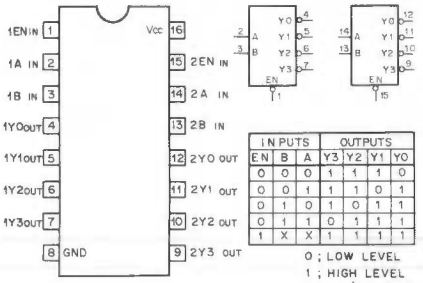
SN7486N (TI)
SN74S86N (TI)
SN74LS86N (TI)
HD74LS86P (HITACHI)
TTL EXCLUSIVE OR GATE
— TOP VIEW —



A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

0;LOW LEVEL
1;HIGH LEVEL

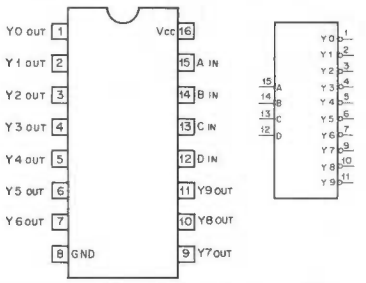
SN74S139N (TI)
SN74LS139N (TI)
TTL 2-TO-4-LINE DECODER/DEMULTIPLXER
—TOP VIEW—



INPUTS			OUTPUTS			
EN	B	A	Y3	Y2	Y1	Y0
0	0	0	1	1	1	0
0	0	1	1	1	0	1
0	1	0	1	0	1	1
0	1	1	0	1	1	1
1	X	X	1	1	1	1

0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE

SN74145N (TI)
SN74LS145N (TI)
TTL BCD-TO-DECIMAL DECODER/DRIVER
— TOP VIEW —

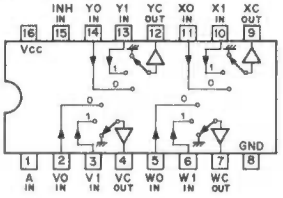


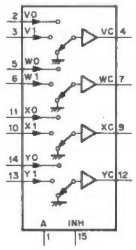
STATE	INPUTS				OUTPUTS								
	D	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
1	0	0	0	1	1	0	1	1	1	1	1	1	1	1
2	0	0	1	0	1	1	0	1	1	1	1	1	1	1
3	0	0	1	1	1	1	1	0	1	1	1	1	1	1
4	0	1	0	0	1	1	1	1	0	1	1	1	1	1
5	0	1	0	1	1	1	1	1	1	0	1	1	1	1
6	0	1	1	0	1	1	1	1	1	1	0	1	1	1
7	0	1	1	1	1	1	1	1	1	1	1	0	1	1
8	1	0	0	0	1	1	1	1	1	1	1	1	0	1
9	1	0	0	1	1	1	1	1	1	1	1	1	1	0
INVALID	1	0	1	0	1	1	1	1	1	1	1	1	1	1
	1	0	1	1	1	1	1	1	1	1	1	1	1	1
	1	1	0	0	1	1	1	1	1	1	1	1	1	1
	1	1	0	1	1	1	1	1	1	1	1	1	1	1
	1	1	1	0	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1	1	1	1	1

0; LOW LEVEL
1; HIGH LEVEL

SN74157N (TI)
SN74L157N (TI)
SN74S157N (TI)
SN74LS157N (TI)
HD74LS157P (HITACHI)
MB74LS157 (FUJITSU)
M74LS157P (MITSUBISHI)

TTL 2-LINE-TO-1-LINE DATA SELECTOR/MULTIPLEXER
—TOP VIEW—

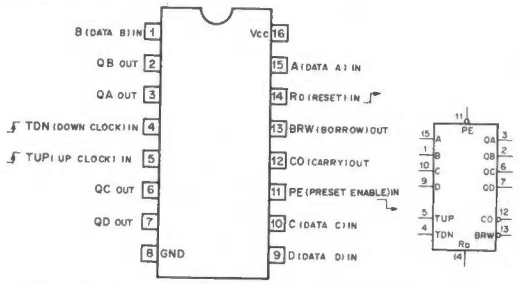




	CONT. IN		ON CHANNEL
	INH	A	
0;LOW LEVEL	0	0	0
1;HIGH LEVEL	0	1	1
X;DON'T CARE	1	X	GND

SN74193N (TI)
SN74L193N (TI)
SN74LS193N (TI)

TTL PRESETTABLE SYNCHRONOUS 4-BIT UP/DOWN COUNTER
—TOP VIEW—

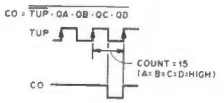


CONTROL INPUTS				MODE
RD	PE	TUP	TDN	
1	X	X	X	RESET TO ZERO
0	0	X	X	PRESET
0	1	↑	1	UP COUNT
0	1	1	↑	DOWN COUNT
0	1	1	1	NO COUNT

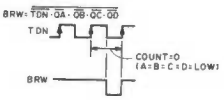
COUNT	OUTPUTS			
	QD	QC	QB	QA
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

UP COUNT
DOWN COUNT

$CO = \overline{TUP \cdot QA \cdot QB \cdot QC \cdot QD}$

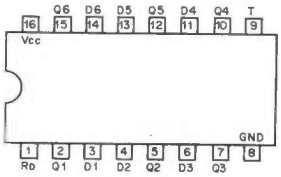


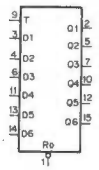
$BRW = \overline{TDN \cdot QA \cdot QB \cdot QC \cdot QD}$

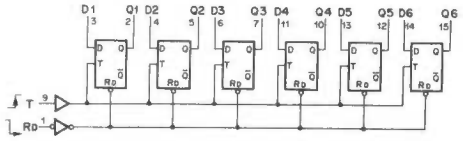


SN74174N (TI)
SN74S174N (TI)
SN74LS174N(TI)
HD74LS174P(HITACHI)
MB74LS174 (FUJITSU)
M74LS174P (MITSUBISHI)

TTL D-TYPE FLIP-FLOP WITH DIRECT RESET
—TOP VIEW—







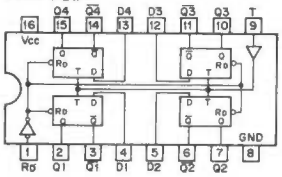
EACH FLIP-FLOP

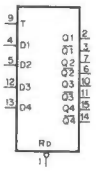
INPUTS			OUT
RD	T	D	Q
0	X	X	0
1	↑	0	0
1	↑	1	1
1	0	X	Q_0

0;LOW LEVEL
1;HIGH LEVEL
X;DON'T CARE

SN74175N (TI)
SN74S175N (TI)
SN74LS175N (TI)
HD74LS175P (HITACHI)

TTL D-TYPE FLIP-FLOP WITH CLEAR
—TOP VIEW—



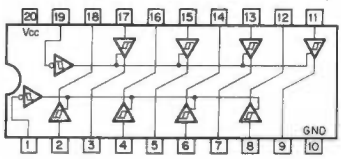


RD	T	D	Q	$\overline{Q}$
0	X	X	0	1
1	↑	1	1	0
1	↑	0	0	1
1	0	X	Q_0	$\overline{Q}_0$

0;LOW LEVEL
1;HIGH LEVEL
X;DON'T CARE

SN74LS244N (TI)
HD74LS244P (HITACHI)
M74LS244P (MITSUBISHI)

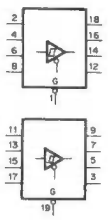
TTL 3-STATE SCHMITT TRIGGER BUFFER/DRIVER
—TOP VIEW—



G	A	Y
0	0	0
0	1	1
1	X	HI-Z

0;LOW LEVEL
1;HIGH LEVEL
X;DON'T CARE
HI-Z;HIGH IMPEDANCE

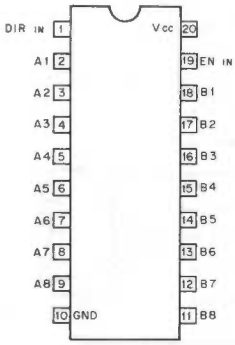
OR



SN74LS245N (TI)

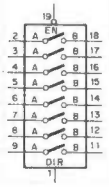
TTL BILATERAL SCHMITT TRIGGER BUS TRANSCEIVERS WITH 3-STATE OUTPUT

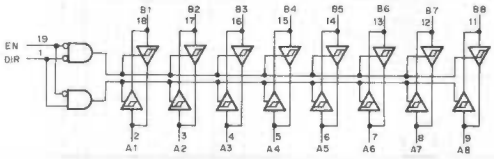
— TOP VIEW —



EN	DIR	OPERATION
0	0	B to A
0	1	A to B
1	X	HI-Z

0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE.

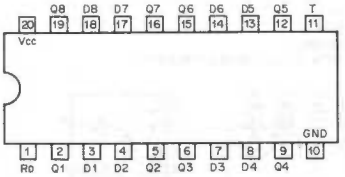


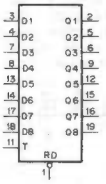


SN74273N (TI)
SN74LS273N (TI)
M74LS273P (MITSUBISHI)

TTL D-TYPE FLIP-FLOP WITH DIRECT RESET

— TOP VIEW —

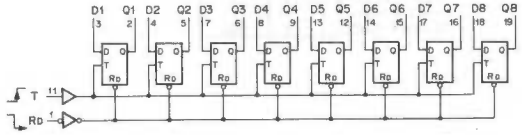




EACH FLIP-FLOP

INPUTS			OUT
RD	T	D	Q
0	X	X	0
1	↑	0	0
1	↑	1	1
1	0	X	Q0

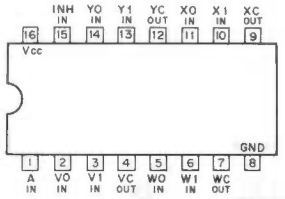
0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE

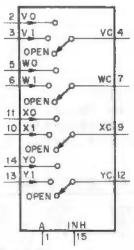


SN74LS257AN(TI)

TTL 2-LINE-TO-1-LINE DATA SELECTOR/MULTIPLEXER

— TOP VIEW —





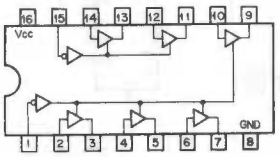
CONT. IN		ON CHANNEL
INH	A	
0	0	0
0	1	1
1	X	OPEN

0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE

SN74367AN (TI)
SN74LS367AN (TI)

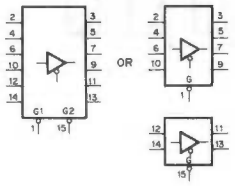
TTL BUS DRIVER WITH 3-STATE OUTPUTS

— TOP VIEW —



G	A	Y
0	0	0
0	1	0
1	X	HI-Z

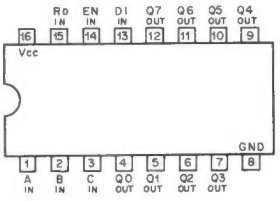
0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE
HI-Z ; HIGH IMPEDANCE

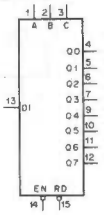


SN74259N (TI)
SN74LS259N (TI)
SN74LS259AN(TI)

TTL 8-BIT ADDRESSABLE LATCHES

— TOP VIEW —





MODE SELECTION

CONTROL INPUTS		OUTPUT OF ADDRESSED LATCH	OUTPUT OF EACH OTHER LATCH
RD	EN		
1	0	D1	Qno
1	1	Qno	Qno
0	0	D1	0
0	1	0	0

0 ; LOW LEVEL
1 ; HIGH LEVEL

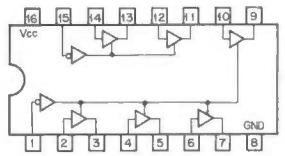
LATCH SELECTION

CONTROL INPUTS			LATCH ADDRESSED
C	B	A	
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

SN74367AN (TI)
SN74LS367AN (TI)

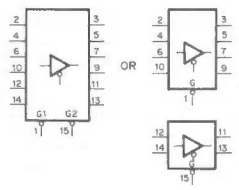
TTL BUS DRIVER WITH 3-STATE OUTPUTS

—TOP VIEW—



G	A	Y
0	0	0
0	1	1
1	X	HI-Z

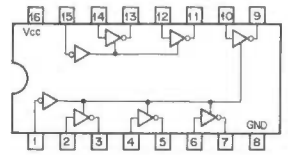
0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE
HI-Z ; HIGH IMPEDANCE



SN74368AN (TI)
SN74LS368AN (TI)

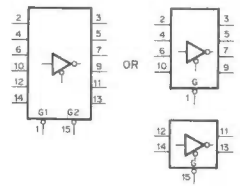
TTL BUS INVERTER WITH 3-STATE OUTPUTS

—TOP VIEW—



G	A	Y
0	0	1
0	1	0
1	X	HI-Z

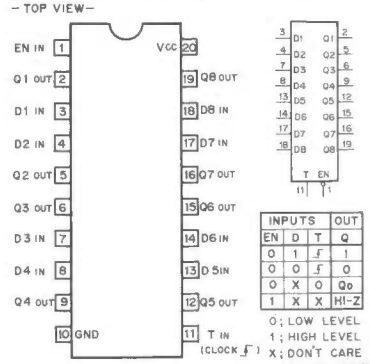
0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE
HI-Z ; HIGH IMPEDANCE



SN74S374N (TI)
SN74LS374N (TI)

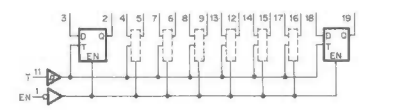
TTL 3-STATE OUTPUTS OCTAL D-TYPE FLIP-FLOP

— TOP VIEW—



INPUTS			OUT
EN	D	T	Q
0	1	↓	1
0	0	↓	0
0	X	0	Q_0
1	X	X	HI-Z

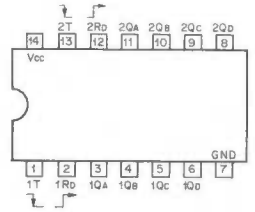
0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE
HI-Z ; HIGH IMPEDANCE

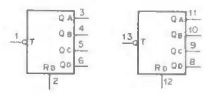


SN74393N (TI)
SN74LS393N (TI)

TTL 4-BIT BINARY COUNTER

—TOP VIEW—





COUNT	QD	QC	QB	QA
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

COUNT SEQUENCE

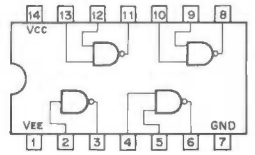
RESET/COUNT FUNCTION					
RD	QD	QC	QB	QA
1	0	0	0	0
0	COUNT			

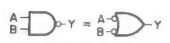
0 ; LOW LEVEL
1 ; HIGH LEVEL

SN75188N (TI)

TTL NAND GATE

— TOP VIEW—





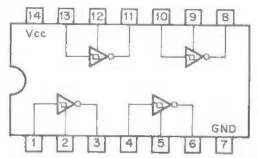
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

0 ; LOW LEVEL
1 ; HIGH LEVEL

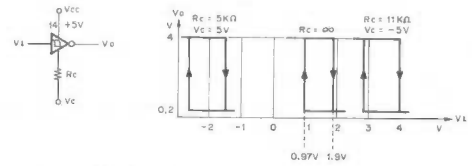
SN75189AN (TI)

QUADRUPLE LINE RECEIVER

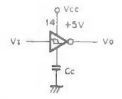
— TOP VIEW —



INPUT THRESHOLD SHIFTING



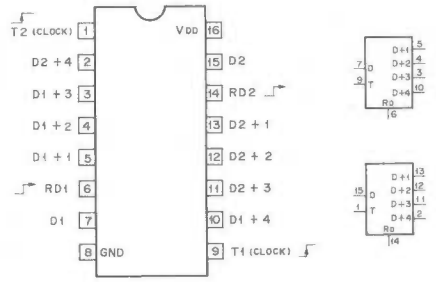
INPUT NOISE FILTERING

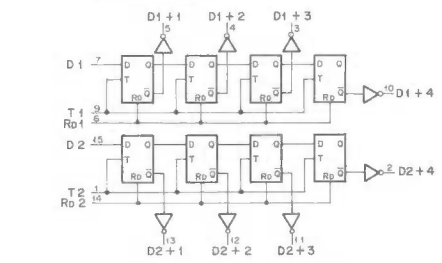


CD4015AE/BE (RCA)
MC14015BCP (MOTOROLA)
TC4015BF (TOSHIBA)
TC4015BP (TOSHIBA)
μPD4015C (NEC)
μPD4015BC (NEC)

C-MOS DUAL 4-STAGE STATIC SHIFT REGISTER WITH DIRECT RESET

— TOP VIEW —

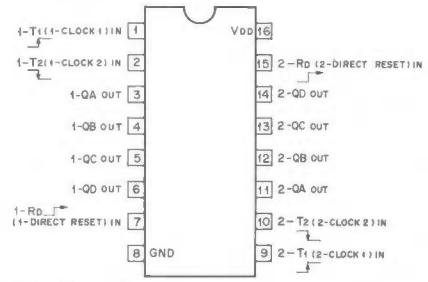




MC14520BCP (MOTOROLA)
CD4520BE (RCA)
TC4520BP (TOSHIBA)
MB84520B (FUJITSU)
HD14520BP (HITACHI)

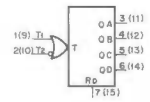
C-MOS DUAL 4-BIT BINARY UP COUNTER

— TOP VIEW —



STATE	OUTPUTS			
	QD	QC	QB	QA
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

0 ; LOW LEVEL
1 ; HIGH LEVEL
X ; DON'T CARE

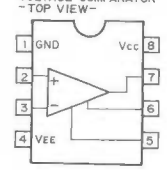


T1	T2	RD	ACTION
↓	1	0	INCREMENT COUNTER
0	↓	0	INCREMENT COUNTER
↓	X	0	NO CHANGE
X	↓	0	NO CHANGE
↓	0	0	NO CHANGE
1	↓	0	NO CHANGE
X	X	1	QA THRU QD = 0

μPC311C (NEC)
μPC311G2 (NEC)

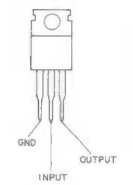
VOLTAGE COMPARATOR

—TOP VIEW—



μA79□□UC (FSC)
FS79□□ (SANKEN)
μPC79□□H (NEC)

NEGATIVE VOLTAGE REGULATOR (1A)



− 5V	μA7905UC	FS7905	μPC7905H
− 6V	μA7906UC		
− 8V	μA7908UC		μPC7908H
−12V	μA7912UC		μPC7912H
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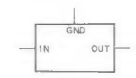
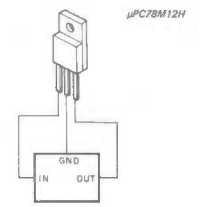
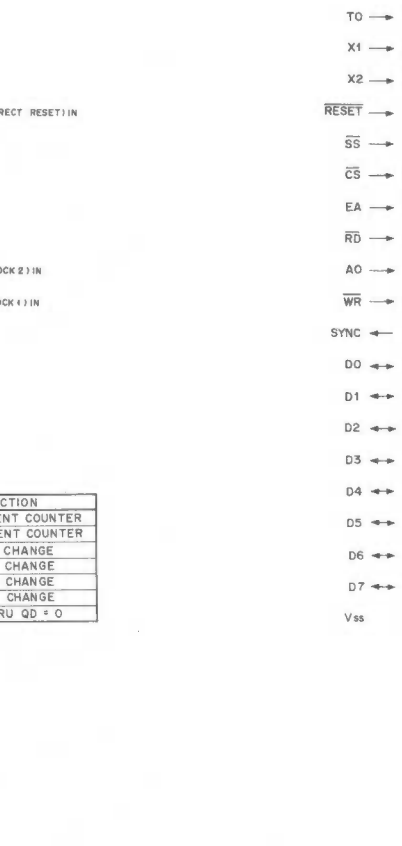
−18V	μA7918UC		μPC7918H
−24V	μA7924UC		μPC7924H

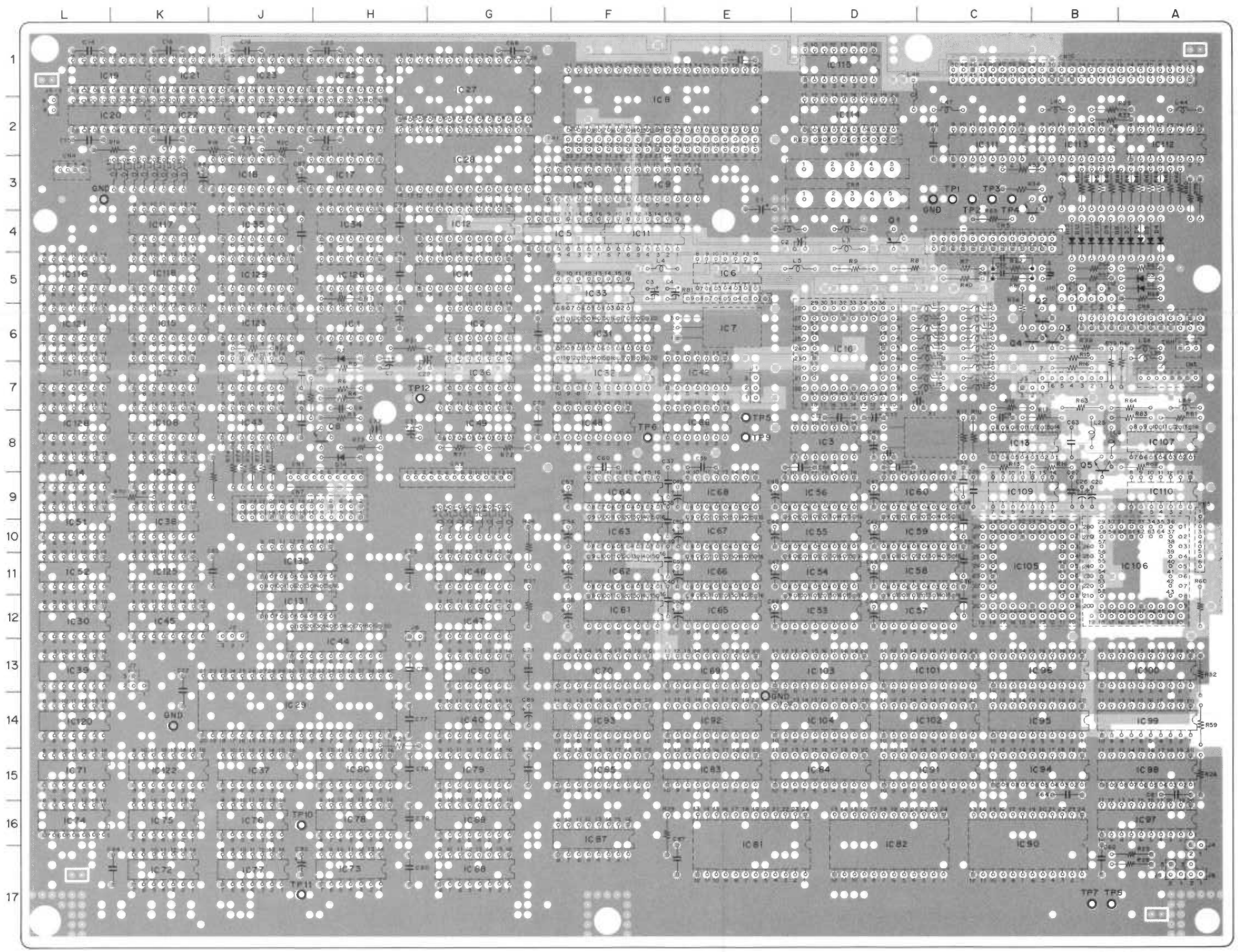




5L8041A-□

—TOP VIEW—





PU-4 – SOLDERING SIDE –
1-608-270-11
SMC-70

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C8	B - 5	D14	H - 8	IC106	A - 11	R4	H - 7				
C9	C - 7			IC107	A - 8	R5	H - 7				
C10	D - 8	IC1	H - 6	IC108	K - 8	R6	H - 7				
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C21	H - 2	IC12	G - 4	IC119	L - 7	R17	B - 7				
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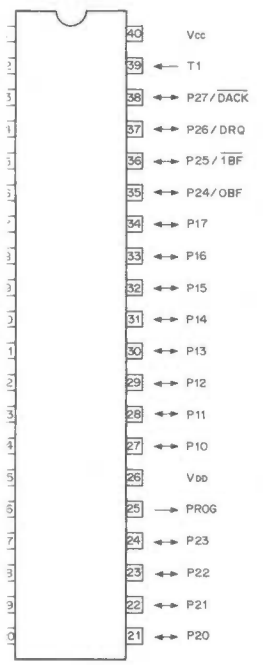
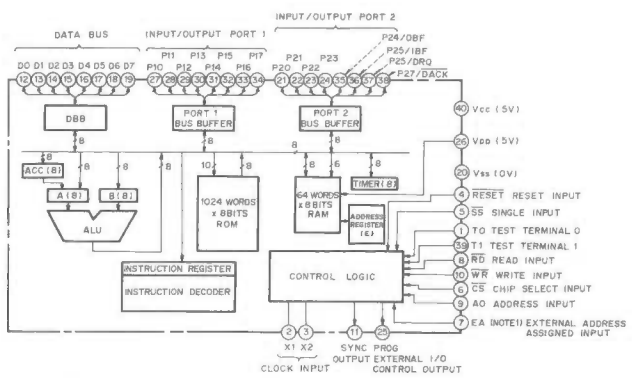
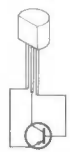
□□P



BLOCK DIAGRAM





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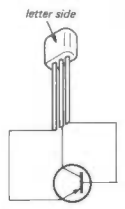

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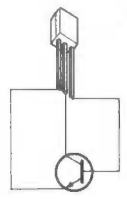

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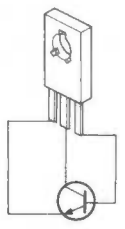

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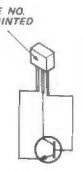

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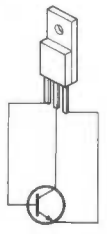

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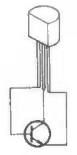

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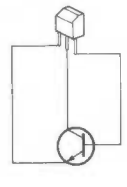

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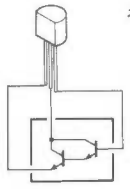

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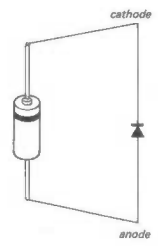

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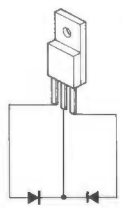

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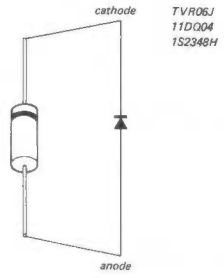

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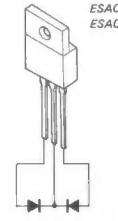

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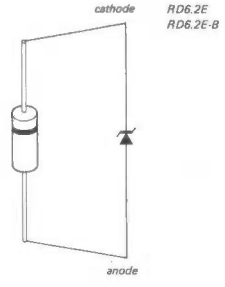
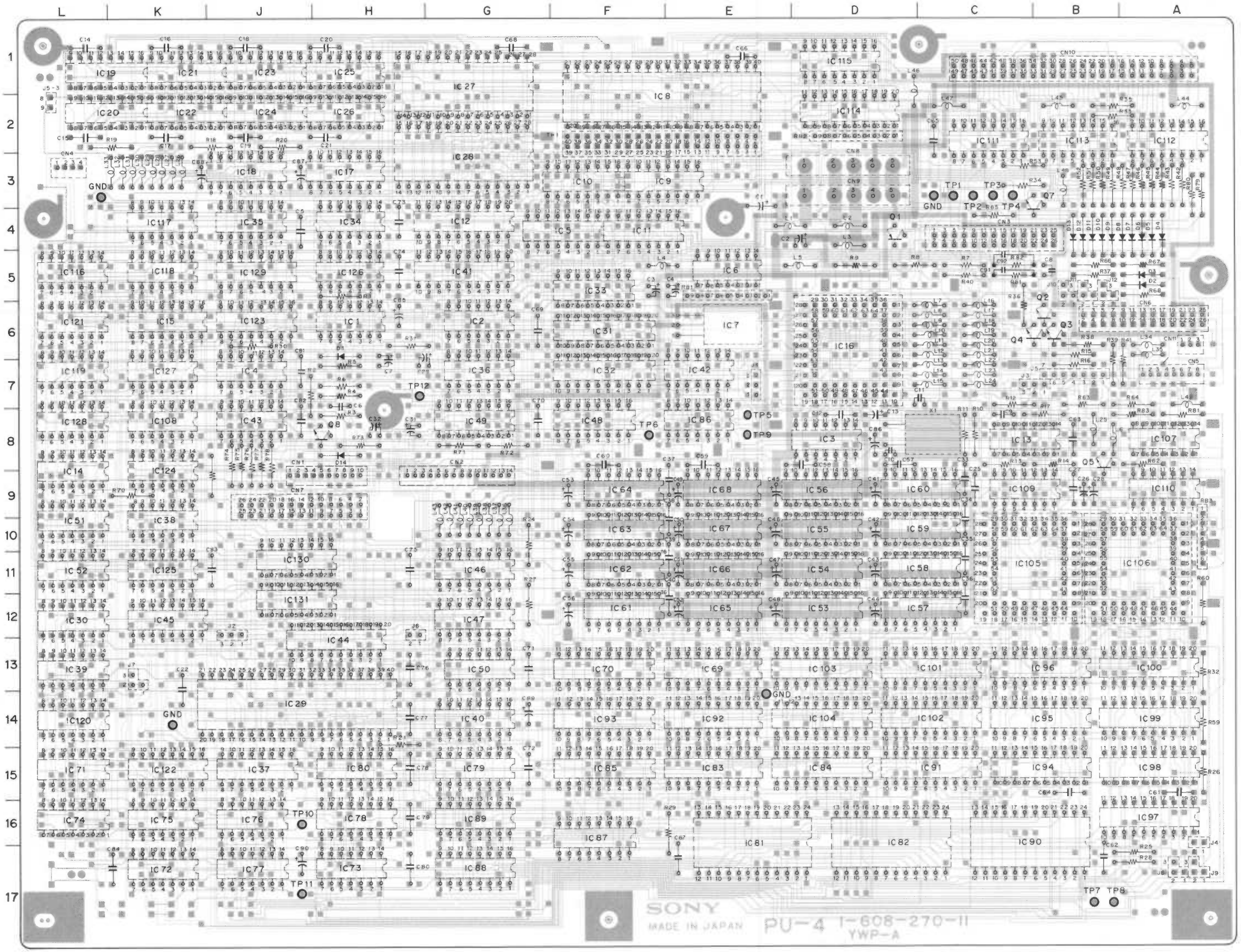


RD6.2E
RD6.2E-B

PU-4 (MAIN BOARD) UP TO S/N 10100



PU-4 – SOLDERING SIDE –
1-608-270-11
SMC-70

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C7	H - 7	D13	B - 4	IC105	C - 11	R3	H - 8				
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C9	C - 7			IC107	A - 8	R5	H - 7				
C10	D - 8	IC1	H - 6	IC108	K - 8	R6	H - 7				
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C54	F - 10	IC43	J - 8	J17	L - 17	R50	B - 3				
C55	F - 11	IC44	H - 13	J18	L - 17	R51	B - 3				
C56	F - 12	IC45	K - 12			R52	B - 3				
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C58	D - 8	IC47	G - 12	L2	D - 4	R59	A - 14				
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C69	G - 6	IC58	D - 11	L13	C - 7	R70	K - 9				
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C71	G - 13	IC60	D - 9	L15	C - 7	R72	G - 8				
C72	G - 15	IC61	F - 12	L16	C - 6	R73	H - 8				
C73	H - 4	IC62	F - 11	L17	C - 6	R74	J - 8				
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C87	J - 3	IC76	J - 16	L31	K - 3						
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C89	G - 14	IC78	H - 16	L33	K - 3						
C90	J - 17	IC79	G - 15	L34	A - 6	TP1	C - 3				
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CN1	H - 9	IC81	E - 17	L36	G - 9	TP3	C - 3				
CN2	G - 9	IC82	D - 17	L37	G - 9	TP4	C - 3				
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CN6	A - 6	IC86	E - 8	L41	G - 9	TP8	B - 17				
CN7	J - 9	IC87	F - 16	L42	G - 9	TP9	E - 8				
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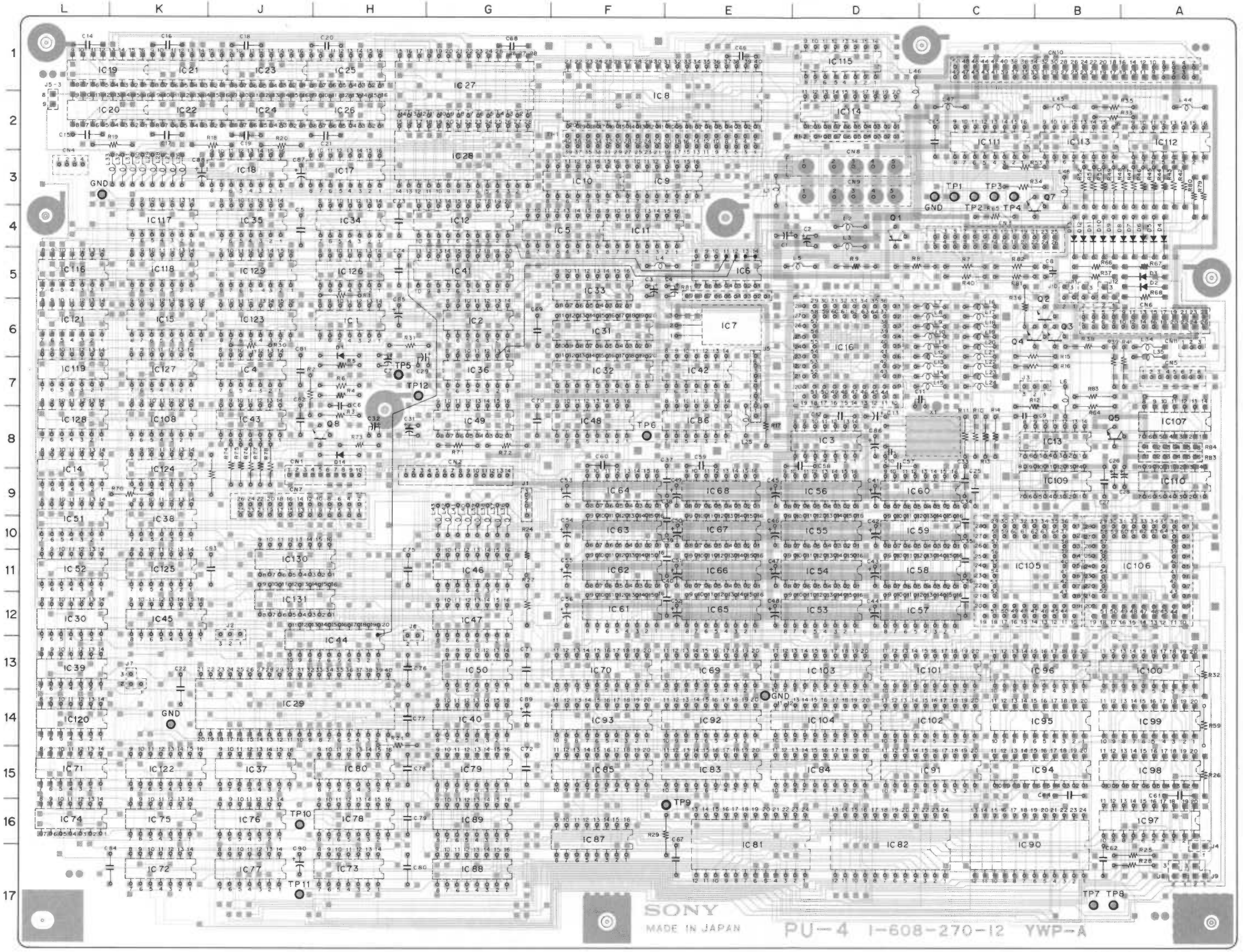
		IC92	E - 14	L47	C - 2	TP-GND	C - 3				
D1	H - 6	IC93	F - 14	L48	B - 3	TP-GND	E - 14				
D2	A - 5	IC94	B - 15	L49	A - 7	TP-GND	K - 14				
D3	A - 5	IC95	B - 14			TP-GND	L - 3				
D4	A - 4	IC96	B - 13	Q1	D - 4						
D5	A - 4	IC97	A - 16	Q2	B - 6	X1	C - 8				
D6	A - 4	IC98	A - 15	Q3	B - 6						

PU-4 (MAIN BOARD) S/N 10101 TO 11900



PU-4 – SOLDERING SIDE –
1-608-270-12
SMC-70

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C3	F - 5	D9	B - 4	IC101	C - 13	Q7	B - 3				
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C9	C - 7			IC107	A - 8	R5	H - 7				
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C11	C - 7	IC2	G - 6	IC109	C - 9	R7	C - 5				
C12	D - 8	IC3	D - 8	IC110	A - 9	R8	D - 5				
C13	D - 8	IC4	J - 7	IC111	C - 2	R9	D - 5				
C14	L - 1	IC5	F - 4	IC112	A - 2	R10	C - 8				
C15	L - 2	IC6	E - 5	IC113	B - 2	R11	C - 8				
C16	K - 1	IC7	E - 6	IC114	D - 2	R12	C - 7				
C17	K - 2	IC8	F - 2	IC115	D - 1	R13	C - 8				
C18	J - 1	IC9	F - 3	IC116	L - 5	R14	B - 8				
C19	J - 2	IC10	F - 3	IC117	K - 4	R15	B - 6				
C20	H - 1	IC11	F - 4	IC118	K - 5	R16	B - 7				
C21	H - 2	IC12	G - 4	IC119	L - 7	R17	B - 7				
C22	K - 13	IC13	C - 8	IC120	L - 14	R18	J - 2				
C25	C - 9	IC14	L - 8	IC121	L - 6	R19	K - 2				
C26	B - 9	IC15	K - 6	IC122	K - 15	R20	J - 2				
C27	B - 9	IC16	D - 6	IC123	J - 6	R21	H - 14				
C28	B - 9	IC17	H - 3	IC124	K - 9	R24	G - 10				
C29	H - 7	IC18	J - 3	IC125	K - 11	R25	A - 17				
C30	B - 9	IC19	L - 1	IC126	H - 5	R26	A - 15				
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C36	C - 12	IC25	H - 1			R32	A - 13				
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D3	A - 5	IC95	B - 14			TP-GND	L - 3				
D4	A - 4	IC96	B - 13	Q1	D - 4						
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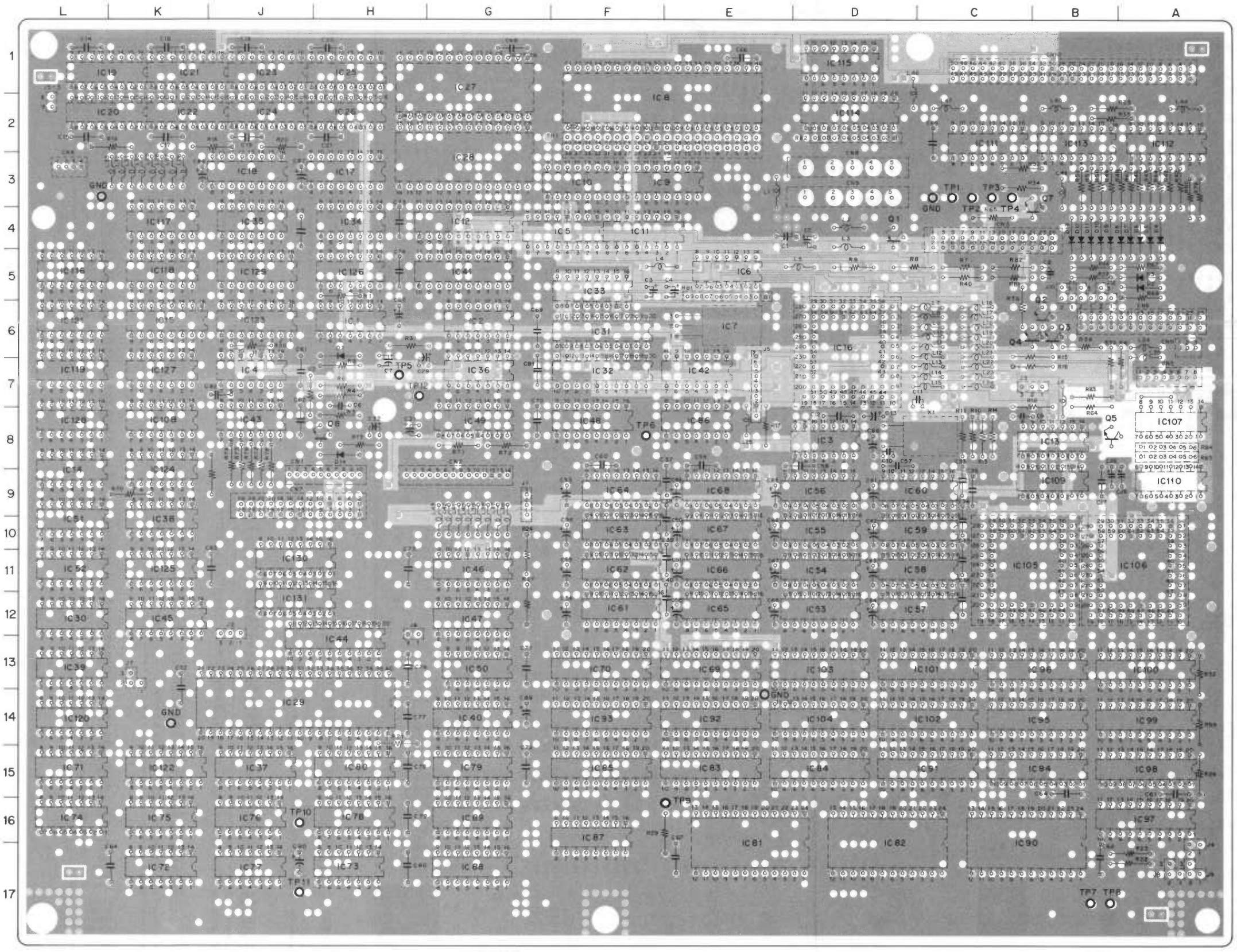

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C10	D · 8	D14	H · 8	IC106	A · 11	R4	H · 7		
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C25	C · 9	IC12	G · 4	IC119	L · 7	R17	B · 7		
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C75	H · 11	IC62	F · 11	L17	C · 6	R74	J · 8		
C76	H · 13	IC63	F · 10	L18	C · 6	R75	J · 8		
C77	H · 14	IC64	F · 9	L19	C · 6	R76	J · 8		
C78	H · 15	IC65	E · 12	L20	C · 6	R77	J · 8		
C79	H · 16	IC66	E · 11	L21	C · 6	R78	J · 8		
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C81	J · 7	IC68	E · 9	L23	C · 7	R80	A · 3		
C82	J · 8	IC69	E · 13	L24	C · 7	R81	C · 5		
C83	J · 11	IC70	F · 13	L25	B · 8	R82	C · 5		
C84	L · 17	IC71	L · 15	L26	K · 3	R83	A · 7		
C85	H · 6	IC72	K · 17	L27	K · 3				
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C87	J · 3	IC74	L · 16	L29	K · 3	RB2	D · 2		
C88	K · 3	IC75	K · 16	L30	K · 3	RB3	A · 10		
C89	G · 14	IC76	J · 16	L31	K · 3				
C90	J · 17	IC77	J · 17	L32	K · 3	TH1	E · 2		
C91	G · 7	IC78	H · 16	L33	K · 3				
C92	J · 7	IC79	G · 15	L34	A · 6	TP1	C · 3		
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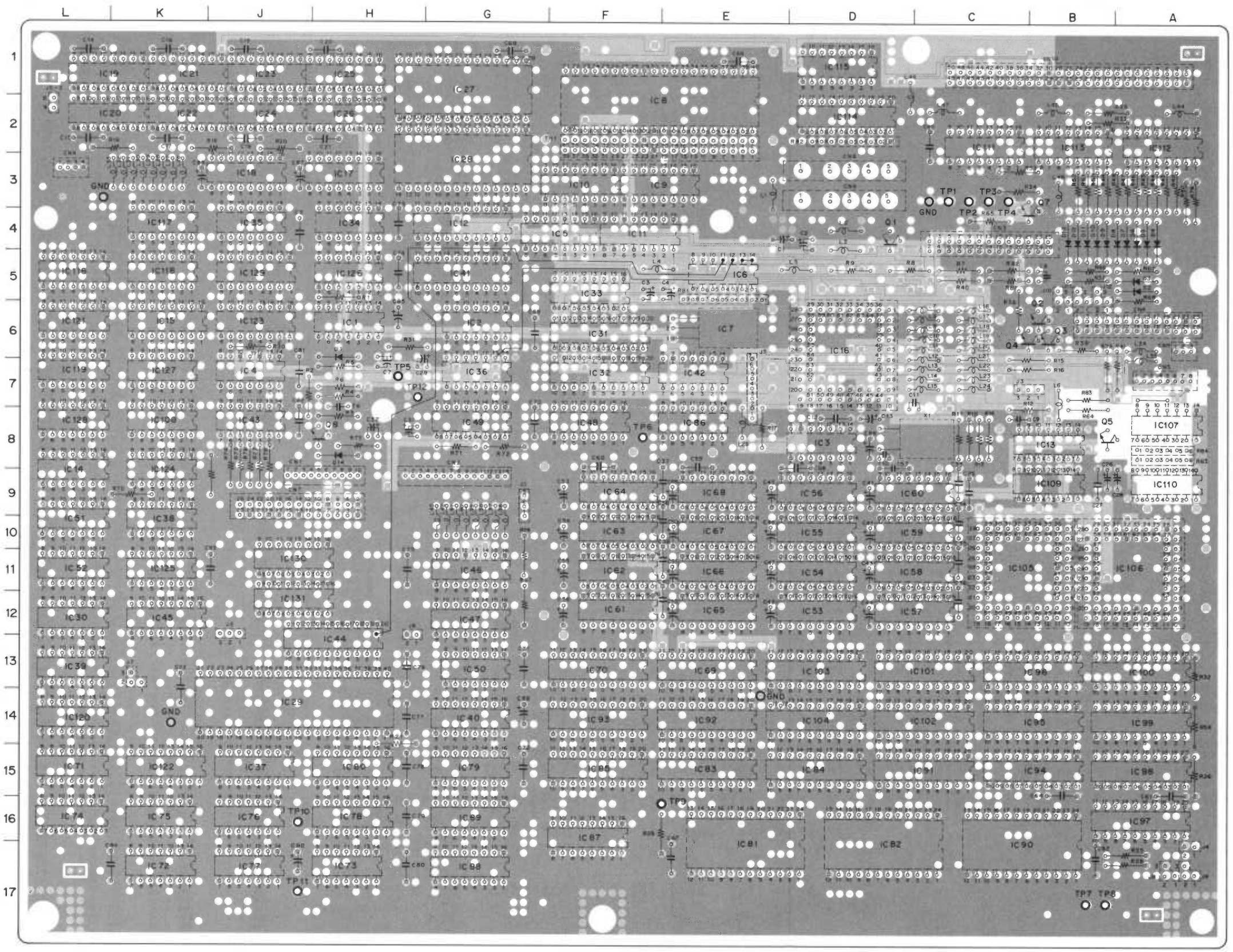
CN11	A · 6	IC91	C · 15	L46	D · 1				
		IC92	E · 14	L47	C · 2	TP-GND	C · 3		
D1	H · 6	IC93	F · 14	L48	B · 3	TP-GND	E · 14		
D2	A · 5	IC94	B · 15	L49	A · 7	TP-GND	K · 14		
D3	A · 5	IC95	B · 14			TP-GND	L · 3		
D4	A · 4	IC96	B · 13	Q1	D · 4				
						X1	C · 8		

PU-4 – SOLDERING SIDE –
1-608-270-13
SMC-70



PU-4 – SOLDERING SIDE –
1-608-270-12
SMC-70

C1	E · 3	D7	A · 4	IC99	A · 14	Q4	B · 6				
C2	D · 4	D8	A · 4	IC100	A · 13	Q5	B · 8				
C3	F · 5	D9	B · 4	IC101	C · 13	Q7	B · 3				
C4	F · 5	D10	B · 4	IC102	C · 14	Q8	H · 8				
C5	J · 4	D11	B · 4	IC103	D · 13						
C6	H · 7	D12	B · 4	IC104	D · 14	R2	J · 7				
C7	H · 7	D13	B · 4	IC105	C · 11	R3	H · 8				
C8	B · 5	D14	H · 8	IC106	A · 11	R4	H · 7				
C9	C · 7			IC107	A · 8	R5	H · 7				
C10	D · 8	IC1	H · 6	IC108	K · 8	R6	H · 7				
C11	C · 7	IC2	G · 6	IC109	C · 9	R7	C · 5				
C12	D · 8	IC3	D · 8	IC110	A · 9	R8	D · 5				
C13	D · 8	IC4	J · 7	IC111	C · 2	R9	D · 5				
C14	L · 1	IC5	F · 4	IC112	A · 2	R10	C · 8				
C15	L · 2	IC6	E · 5	IC113	B · 2	R11	C · 8				
C16	K · 1	IC7	E · 6	IC114	D · 2	R12	C · 7				
C17	K · 2	IC8	F · 2	IC115	D · 1	R13	C · 8				
C18	J · 1	IC9	F · 3	IC116	L · 5	R14	B · 8				
C19	J · 2	IC10	F · 3	IC117	K · 4	R15	B · 6				
C20	H · 1	IC11	F · 4	IC118	K · 5	R16	B · 7				
C21	H · 2	IC12	G · 4	IC119	L · 7	R17	B · 7				
C22	K · 13	IC13	C · 8	IC120	L · 14	R18	J · 2				
C25	C · 9	IC14	L · 8	IC121	L · 6	R19	K · 2				
C26	B · 9	IC15	K · 6	IC122	K · 15	R20	J · 2				
C27	B · 9	IC16	D · 6	IC123	J · 6	R21	H · 14				
C28	B · 9	IC17	H · 3	IC124	K · 9	R24	G · 10				
C29	H · 7	IC18	J · 3	IC125	K · 11	R25	A · 17				
C30	B · 9	IC19	L · 1	IC126	H · 5	R26	A · 15				
C31	H · 8	IC20	L · 2	IC127	K · 7	R27	G · 12				
C32	H · 8	IC21	K · 1	IC128	L · 8	R28	A · 17				
C33	C · 9	IC22	K · 2	IC129	J · 5	R29	F · 16				
C34	C · 10	IC23	J · 1	IC130	J · 11	R30	J · 6				
C35	C · 11	IC24	J · 2	IC131	J · 12	R31	H · 6				
C36	C · 12	IC25	H · 1			R32	A · 13				
C37	F · 9	IC26	H · 2	J1	E · 7	R33	B · 2				
C38	F · 10	IC27	G · 1	J2	J · 12	R34	C · 3				
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C40	F · 12	IC29	J · 14	J4	A · 17	R36	C · 5				
C41	D · 9	IC30	L · 12	J5	B · 7	R37	B · 5				
C42	D · 10	IC31	F · 6	J5-3	L · 2	R38	B · 6				
C43	D · 11	IC32	F · 7	J6	H · 12	R39	B · 7				
C44	D · 12	IC33	F · 5	J7	K · 13	R40	C · 5				
C45	E · 9	IC34	H · 4	J8	A · 17	R41	A · 7				
C46	E · 10	IC35	J · 4	J9	A · 17	R42	A · 3				
C47	E · 11	IC36	G · 7	J10	B · 5	R43	A · 3				
C48	E · 12	IC37	J · 15	J11	B · 5	R44	A · 3				
C49	E · 9	IC38	K · 10	J12	B · 5	R45	A · 3				
C50	E · 10	IC39	L · 13	J13	L · 17	R46	A · 3				
C51	E · 11	IC40	G · 14	J14	K · 17	R47	A · 3				
C52	E · 12	IC41	G · 5	J15	K · 17	R48	A · 3				
C53	F · 9	IC42	E · 7	J16	L · 17	R49	B · 3				
C54	F · 10	IC43	J · 8	J17	L · 17	R50	B · 3				
C55	F · 11	IC44	H · 13	J18	L · 17	R51	B · 3				
C56	F · 12	IC45	K · 12			R52	B · 3				
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C58	D · 8	IC47	G · 12	L2	D · 4	R59	A · 14				
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C62	B · 17	IC51	L · 10	L6	B · 8	R63	B · 7				
C63	B · 8	IC52	L · 11	L7	C · 6	R64	A · 7				
C64	B · 15	IC53	D · 12	L8	C · 6	R65	C · 4				
C65	C · 2	IC54	D · 11	L9	C · 6	R66	B · 5				
C66	E · 1	IC55	D · 10	L10	C · 6	R67	A · 5				
C67	E · 17	IC56	D · 9	L11	C · 6	R68	A · 5				
C68	G · 1	IC57	D · 12	L12	C · 6	R69	K · 9				
C69	G · 6	IC58	D · 11	L13	C · 7	R70	K · 9				
C70	G · 8	IC59	D · 10	L14	C · 7	R71	G · 8				
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C72	G · 15	IC61	F · 12	L16	C · 6	R73	H · 8				
C73	H · 4	IC62	F · 11	L17	C · 6	R74	J · 8				
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C75	H · 11	IC64	F · 9	L19	C · 6	R76	J · 8				
C76	H · 13	IC65	E · 12	L20	C · 6	R77	J · 8				
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C78	H · 15	IC67	E · 10	L22	C · 7	R79	A · 3				
C79	H · 16	IC68	E · 9	L23	C · 7	R80	A · 3				
C80	H · 17	IC69	E · 13	L24	C · 7	R81	C · 5				
C81	J · 7	IC70	F · 13	L25	B · 8	R82	C · 5				
C82	J · 8	IC71	L · 15	L26	K · 3	R83	A · 7				
C83	J · 11	IC72	K · 17	L27	K · 3						
C84	L · 17	IC73	H · 17	L28	K · 3	RB1	E · 5				
C85	H · 6	IC74	L · 16	L29	K · 3	RB2	D · 2				
C86	D · 8	IC75	K · 16	L30	K · 3	RB3	A · 10				
C87	J · 3	IC76	J · 16	L31	K · 3						
C88	K · 3	IC77	J · 17	L32	K · 3	TH1	E · 2				
C89	G · 14	IC78	H · 16	L33	K · 3						
C90	J · 17	IC79	G · 15	L34	A · 6	TP1	C · 3				
		IC80	H · 15	L35	A · 6	TP2	C · 3				
CN1	H · 9	IC81	E · 17	L36	G · 9	TP3	C · 3				
CN2	G · 9	IC82	D · 17	L37	G · 9	TP4	C · 3				
CN3	C · 4	IC83	E · 15	L38	G · 9	TP5	E · 8				
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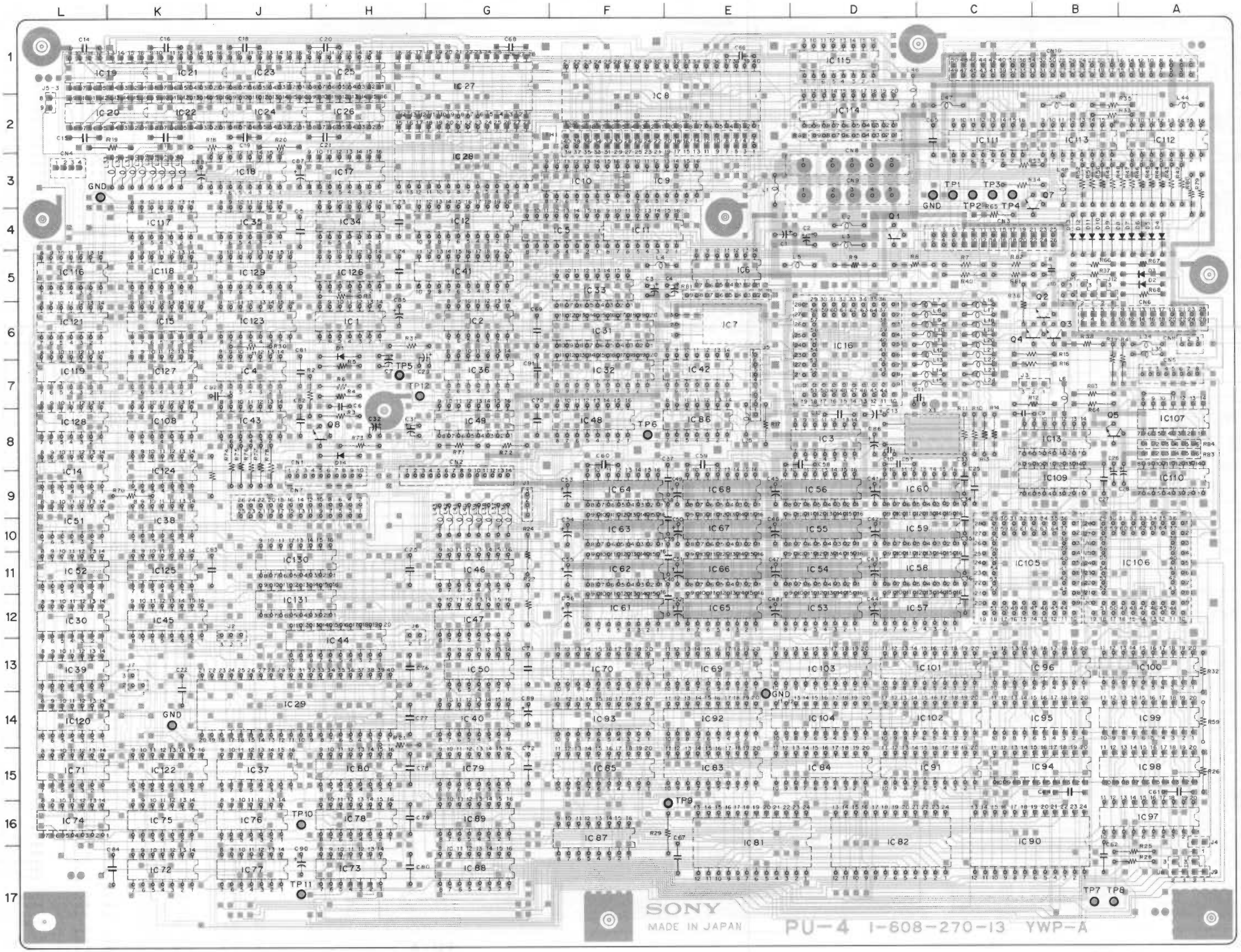
CN6	A · 6	IC86	E · 8	L41	G · 9	TP8	B · 17				
CN7	J · 9	IC87	F · 16	L42	G · 9	TP9	E · 8				
CN8	D · 3	IC88	G · 17	L43	G · 9	TP10	J · 16				
CN9	D · 3	IC89	G · 16	L44	A · 2	TP11	J · 17				
CN10	B · 1	IC90	C · 17	L45	B · 2	TP12	H · 7				
CN11	A · 6	IC91	C · 15	L46	D · 1						
		IC92	E · 14	L47	C · 2	TP-GND	C · 3				
D1	H · 6	IC93	F · 14	L48	B · 3	TP-GND	E · 14				
D2	A · 5	IC94	B · 15	L49	A · 7	TP-GND	K · 14				
D3	A · 5	IC95	B · 14			TP-GND	L · 3				
D4	A · 4	IC96	B · 13	Q1	D · 4						
D5	A · 4	IC97	A · 16	Q2	B · 6	X1	C · 8				
D6	A · 4	IC98	A · 15	Q3	B · 6						

PU-4 (MAIN BOARD) S/N 11901 AND HIGHER


L K J H G F E D C B A
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
GND
TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12
SONY
MADE IN JAPAN
PU-4 1-608-270-13 YWP-A

PU-4 – SOLDERING SIDE –
1-608-270-13
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C1	E · 3	D5	A · 4	IC97	A · 16	Q2	B · 6				
C2	D · 4	D6	A · 4	IC98	A · 15	Q3	B · 6				
C3	F · 5	D7	A · 4	IC99	A · 14	Q4	B · 6				
C4	F · 5	D8	A · 4	IC100	A · 13	Q5	B · 8				
C5	J · 4	D9	B · 4	IC101	C · 13	Q7	B · 3				
C6	H · 7	D10	B · 4	IC102	C · 14	Q8	H · 8				
C7	H · 7	D11	B · 4	IC103	D · 13						
C8	B · 5	D12	B · 4	IC104	D · 14	R2	J · 7				
C9	C · 7	D13	B · 4	IC105	C · 11	R3	H · 8				
C10	D · 8	D14	H · 8	IC106	A · 11	R4	H · 7				
C11	C · 7			IC107	A · 8	R5	H · 7				
C12	D · 8	IC1	H · 6	IC108	K · 8	R6	H · 7				
C13	D · 8	IC2	G · 6	IC109	C · 9	R7	C · 5				
C14	L · 1	IC3	D · 8	IC110	A · 9	R8	D · 5				
C15	L · 2	IC4	J · 7	IC111	C · 2	R9	D · 5				
C16	K · 1	IC5	F · 4	IC112	A · 2	R10	C · 8				
C17	K · 2	IC6	E · 5	IC113	B · 2	R11	C · 8				
C18	J · 1	IC7	E · 6	IC114	D · 2	R12	C · 7				
C19	J · 2	IC8	F · 2	IC115	D · 1	R13	C · 8				
C20	H · 1	IC9	F · 3	IC116	L · 5	R14	B · 8				
C21	H · 2	IC10	F · 3	IC117	K · 4	R15	B · 6				
C22	K · 13	IC11	F · 4	IC118	K · 5	R16	B · 7				
C25	C · 9	IC12	G · 4	IC119	L · 7	R17	B · 7				
C26	B · 9	IC13	C · 8	IC120	L · 14	R18	J · 2				
C27	B · 9	IC14	L · 8	IC121	L · 6	R19	K · 2				
C28	B · 9	IC15	K · 6	IC122	K · 15	R20	J · 2				
C29	H · 7	IC16	D · 6	IC123	J · 6	R21	H · 14				
C30	B · 9	IC17	H · 3	IC124	K · 9	R24	G · 10				
C31	H · 8	IC18	J · 3	IC125	K · 11	R25	A · 17				
C32	H · 8	IC19	L · 1	IC126	H · 5	R26	A · 15				
C33	C · 9	IC20	L · 2	IC127	K · 7	R27	G · 12				
C34	C · 10	IC21	K · 1	IC128	L · 8	R28	A · 17				
C35	C · 11	IC22	K · 2	IC129	J · 5	R29	F · 16				
C36	C · 12	IC23	J · 1	IC130	J · 11	R30	J · 6				
C37	F · 9	IC24	J · 2	IC131	J · 12	R31	H · 6				
C38	F · 10	IC25	H · 1			R32	A · 13				
C39	F · 11	IC26	H · 2	J1	E · 7	R33	B · 2				
C40	F · 12	IC27	G · 1	J2	J · 12	R34	C · 3				
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C42	D · 10	IC29	J · 14	J4	A · 17	R36	C · 5				
C43	D · 11	IC30	L · 12	J5	B · 7	R37	B · 5				
C44	D · 12	IC31	F · 6	J5-3	L · 2	R38	B · 6				
C45	E · 9	IC32	F · 7	J6	H · 12	R39	B · 7				
C46	E · 10	IC33	F · 5	J7	K · 13	R40	C · 5				
C47	E · 11	IC34	H · 4	J8	A · 17	R41	A · 7				
C48	E · 12	IC35	J · 4	J9	A · 17	R42	A · 3				
C49	E · 9	IC36	G · 7	J10	B · 5	R43	A · 3				
C50	E · 10	IC37	J · 15	J11	B · 5	R44	A · 3				
C51	E · 11	IC38	K · 10	J12	B · 5	R45	A · 3				
C52	E · 12	IC39	L · 13	J13	L · 17	R46	A · 3				
C53	F · 9	IC40	G · 14	J14	K · 17	R47	A · 3				
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C55	F · 11	IC42	E · 7	J16	L · 17	R49	B · 3				
C56	F · 12	IC43	J · 8	J17	L · 17	R50	B · 3				
C57	D · 8	IC44	H · 13	J18	L · 17	R51	B · 3				
C58	D · 8	IC45	K · 12			R52	B · 3				
C59	E · 8	IC46	G · 11	L1	D · 4	R53	C · 3				
C60	F · 8	IC47	G · 12	L2	D · 4	R59	A · 14				
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C62	B · 17	IC49	G · 8	L4	F · 5	R61	A · 8				
C63	B · 8	IC50	G · 13	L5	D · 5	R62	A · 8				
C64	B · 15	IC51	L · 10	L6	B · 8	R63	B · 7				
C65	C · 2	IC52	L · 11	L7	C · 6	R64	A · 7				
C66	E · 1	IC53	D · 12	L8	C · 6	R65	C · 4				
C67	E · 17	IC54	D · 11	L9	C · 6	R66	B · 5				
C68	G · 1	IC55	D · 10	L10	C · 6	R67	A · 5				
C69	G · 6	IC56	D · 9	L11	C · 6	R68	A · 5				
C70	G · 8	IC57	D · 12	L12	C · 6	R69	K · 9				
C71	G · 13	IC58	D · 11	L13	C · 7	R70	K · 9				
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C73	H · 4	IC60	D · 9	L15	C · 7	R72	G · 8				
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C75	H · 11	IC62	F · 11	L17	C · 6	R74	J · 8				
C76	H · 13	IC63	F · 10	L18	C · 6	R75	J · 8				
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C78	H · 15	IC65	E · 12	L20	C · 6	R77	J · 8				
C79	H · 16	IC66	E · 11	L21	C · 6	R78	J · 8				
C80	H · 17	IC67	E · 10	L22	C · 7	R79	A · 3				
C81	J · 7	IC68	E · 9	L23	C · 7	R80	A · 3				
C82	J · 8	IC69	E · 13	L24	C · 7	R81	C · 5				
C83	J · 11	IC70	F · 13	L25	B · 8	R82	C · 5				
C84	L · 17	IC71	L · 15	L26	K · 3	R83	A · 7				
C85	H · 6	IC72	K · 17	L27	K · 3						
C86	D · 8	IC73	H · 17	L28	K · 3	RB1	E · 5				
C87	J · 3	IC74	L · 16	L29	K · 3	RB2	D · 2				
C88	K · 3	IC75	K · 16	L30	K · 3	RB3	A · 10				
C89	G · 14	IC76	J · 16	L31	K · 3						
C90	J · 17	IC77	J · 17	L32	K · 3	TH1	E · 2				
C91	G · 7	IC78	H · 16	L33	K · 3						
C92	J · 7	IC79	G · 15	L34	A · 6	TP1	C · 3				
		IC80	H · 15	L35	A · 6	TP2	C · 3				
CN1	H · 9	IC81	E · 17	L36	G · 9	TP3	C · 3				
CN2	G · 9	IC82	D · 17	L37	G · 9	TP4	C · 3				
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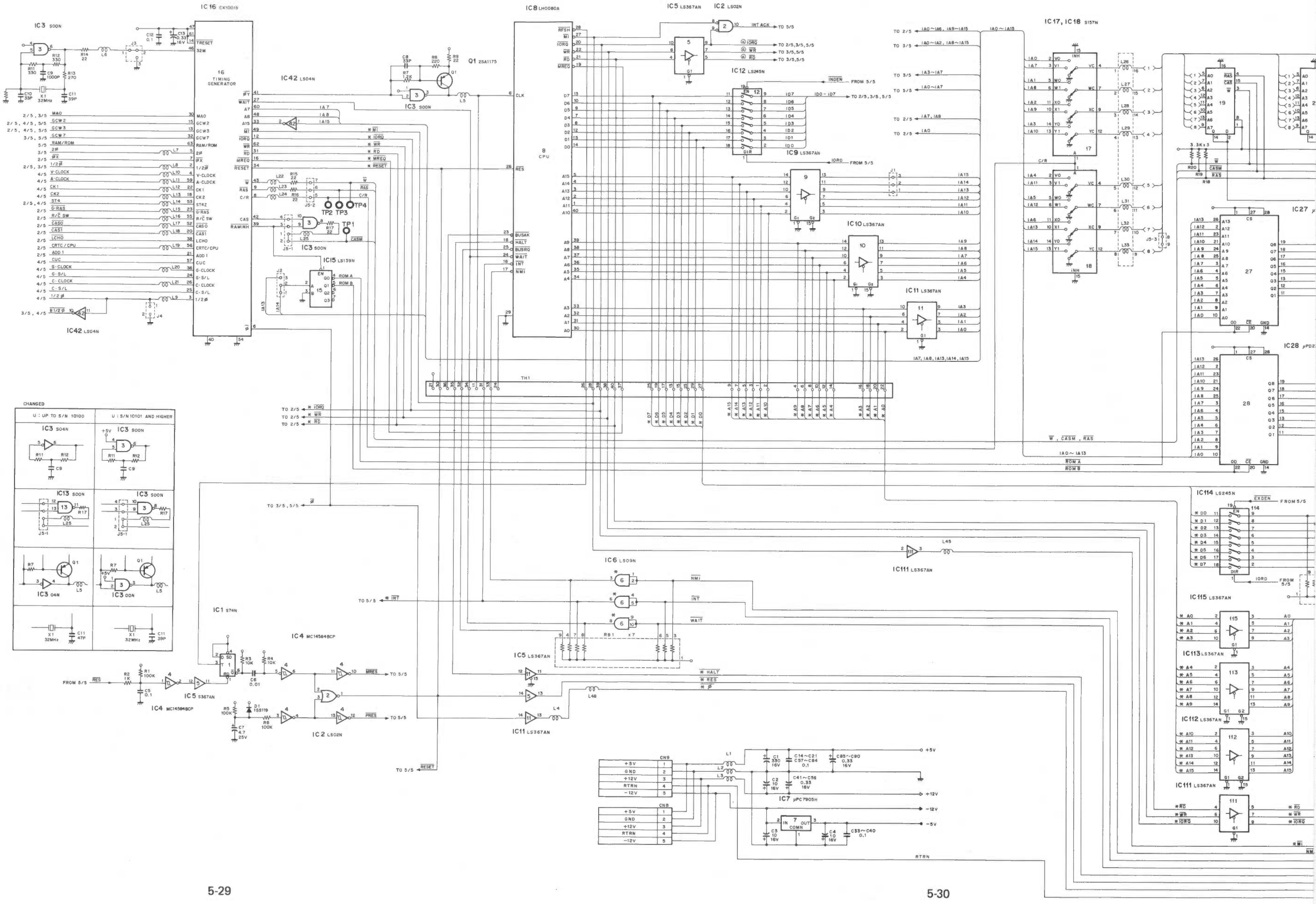
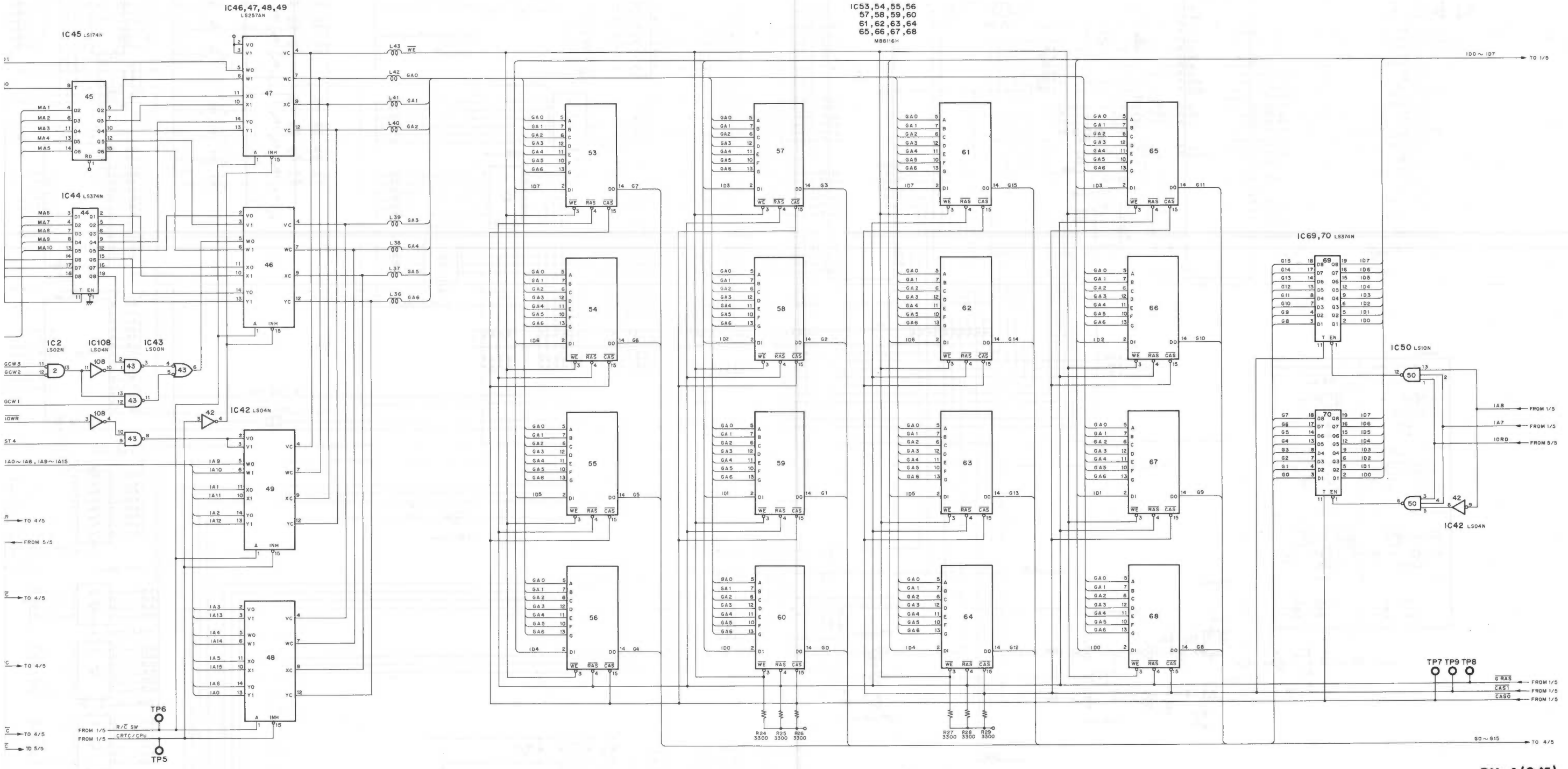
CN4	L · 3	IC84	D · 15	L39	G · 9	TP6	F · 8				
CN5	A · 7	IC85	F · 15	L40	G · 9	TP7	B · 17				
CN6	A · 6	IC86	E · 8	L41	G · 9	TP8	B · 17				
CN7	J · 9	IC87	F · 16	L42	G · 9	TP9	E · 8				
CN8	D · 3	IC88	G · 17	L43	G · 9	TP10	J · 16				
CN9	D · 3	IC89	G · 16	L44	A · 2	TP11	J · 17				
CN10	B · 1	IC90	C · 17	L45	B · 2	TP12	H · 7				
CN11	A · 6	IC91	C · 15	L46	D · 1						
		IC92	E · 14	L47	C · 2	TP-GND	C · 3				
D1	H · 6	IC93	F · 14	L48	B · 3	TP-GND	E · 14				
D2	A · 5	IC94	B · 15	L49	A · 7	TP-GND	K · 14				
D3	A · 5	IC95	B · 14			TP-GND	L · 3				
D4	A · 4	IC96	B · 13	Q1	D · 4						
						X1	C · 8				

PU-4 (MAIN BOARD)1/5





PU-4 (2/5)
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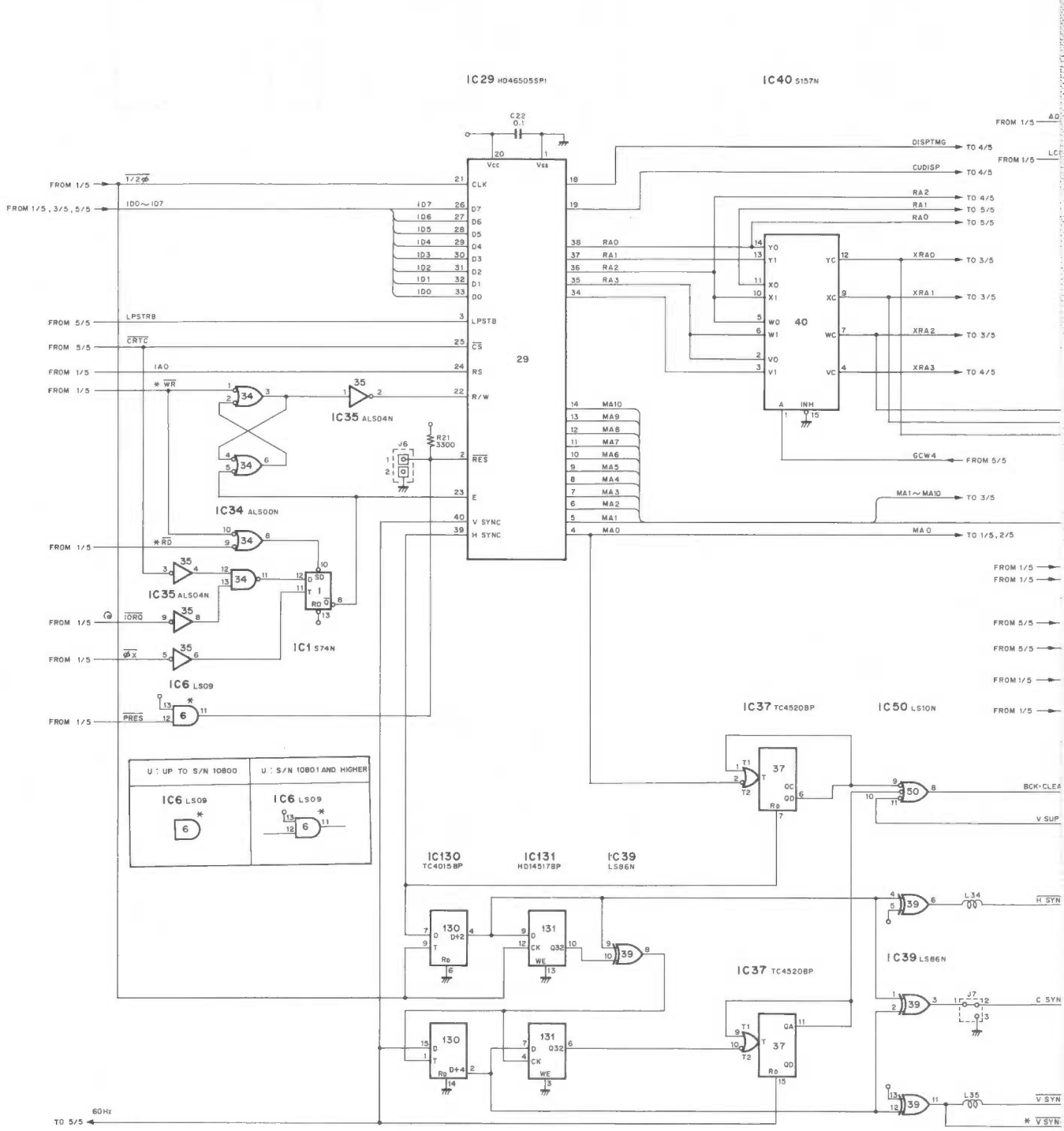
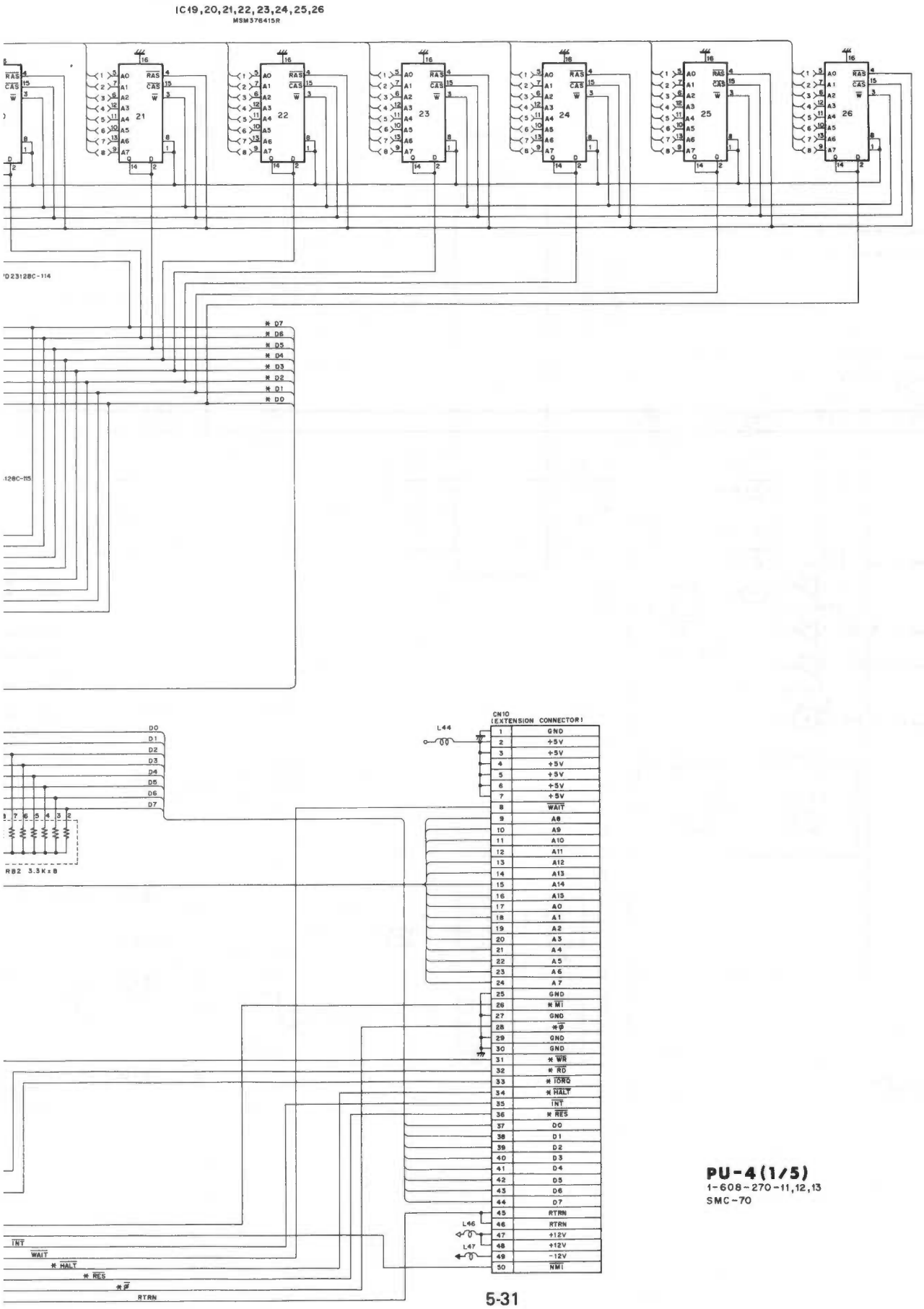
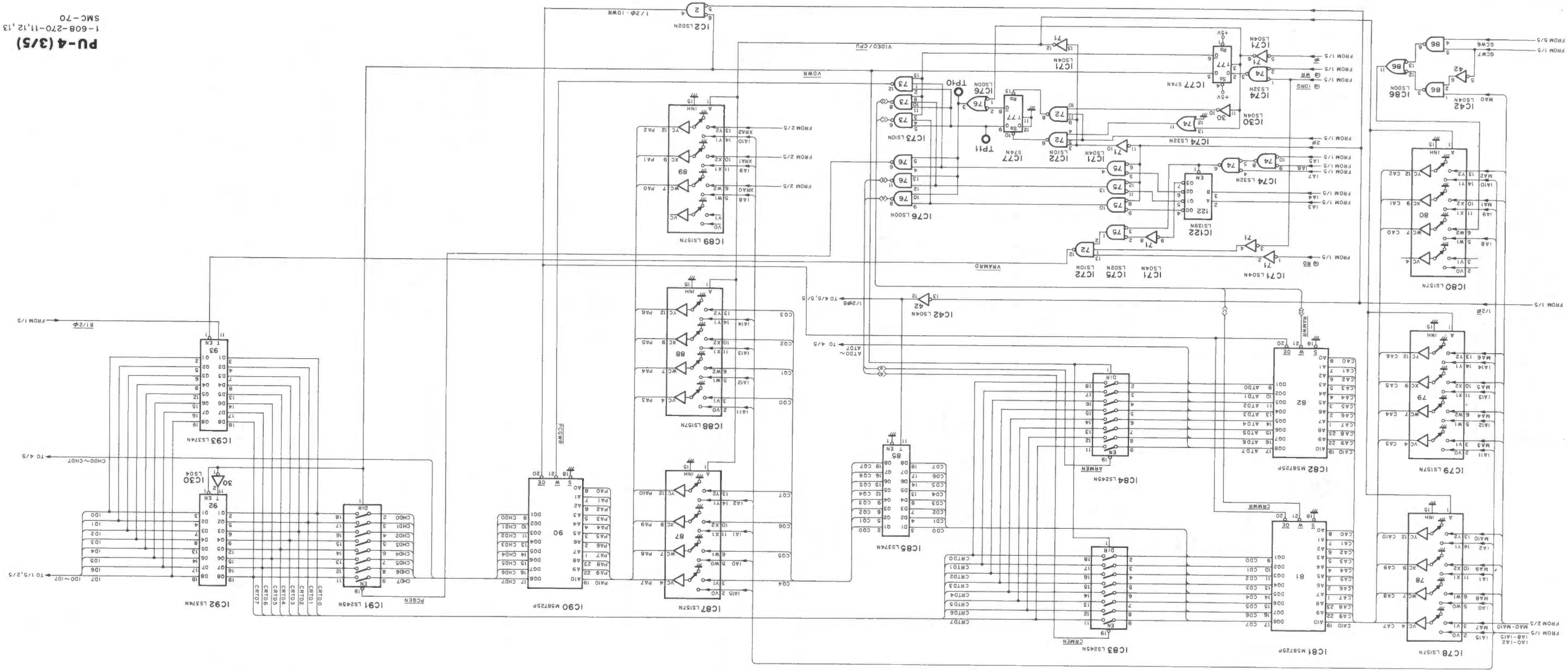
PU-4 (MAIN BOARD)2/5





PU-4(1/5)
1-608-270-11,12,13
SMC-70



PU-4 (MAIN BOARD)3/5

PU-4 (3/5)
1-608-270-11,12,13
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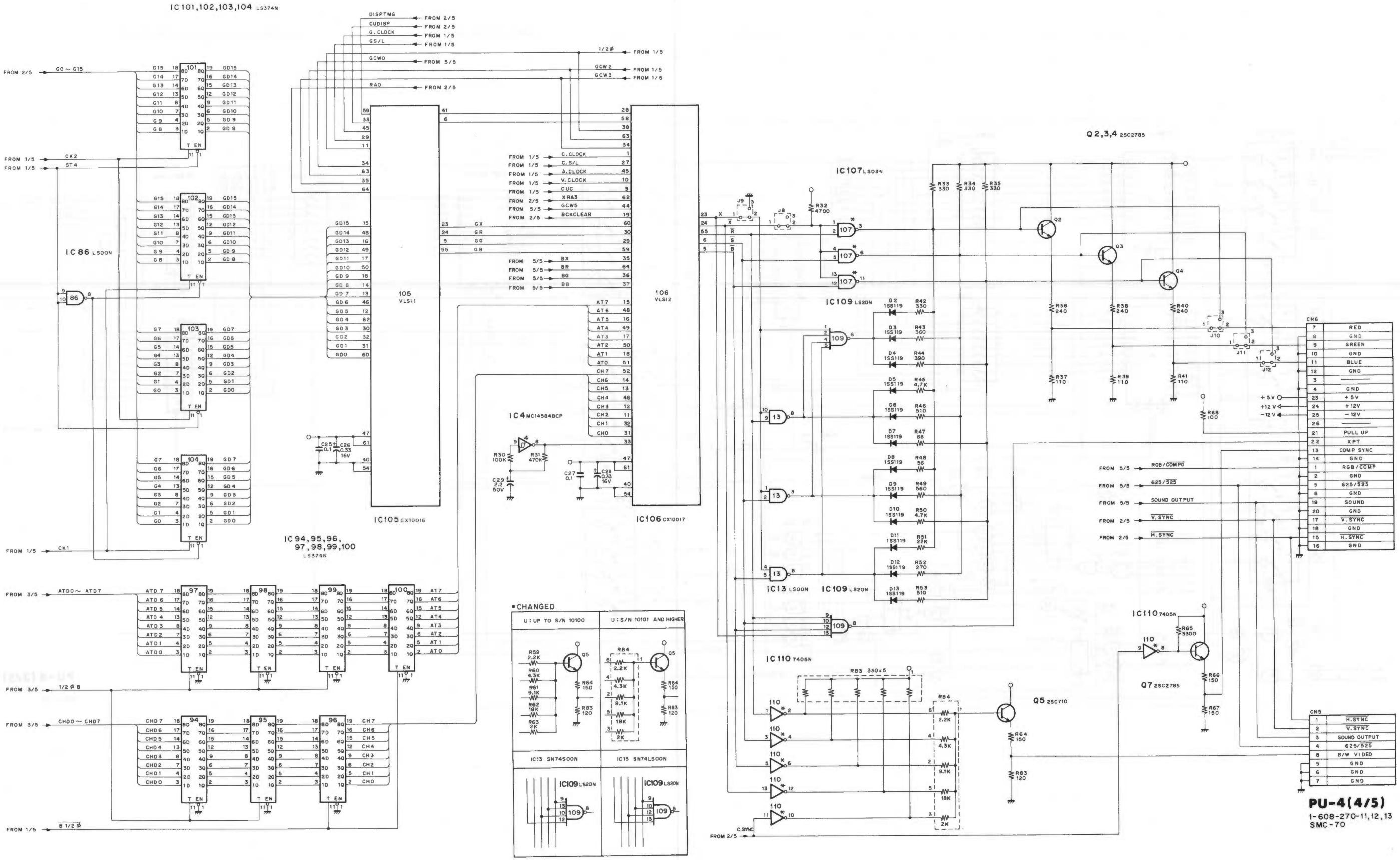
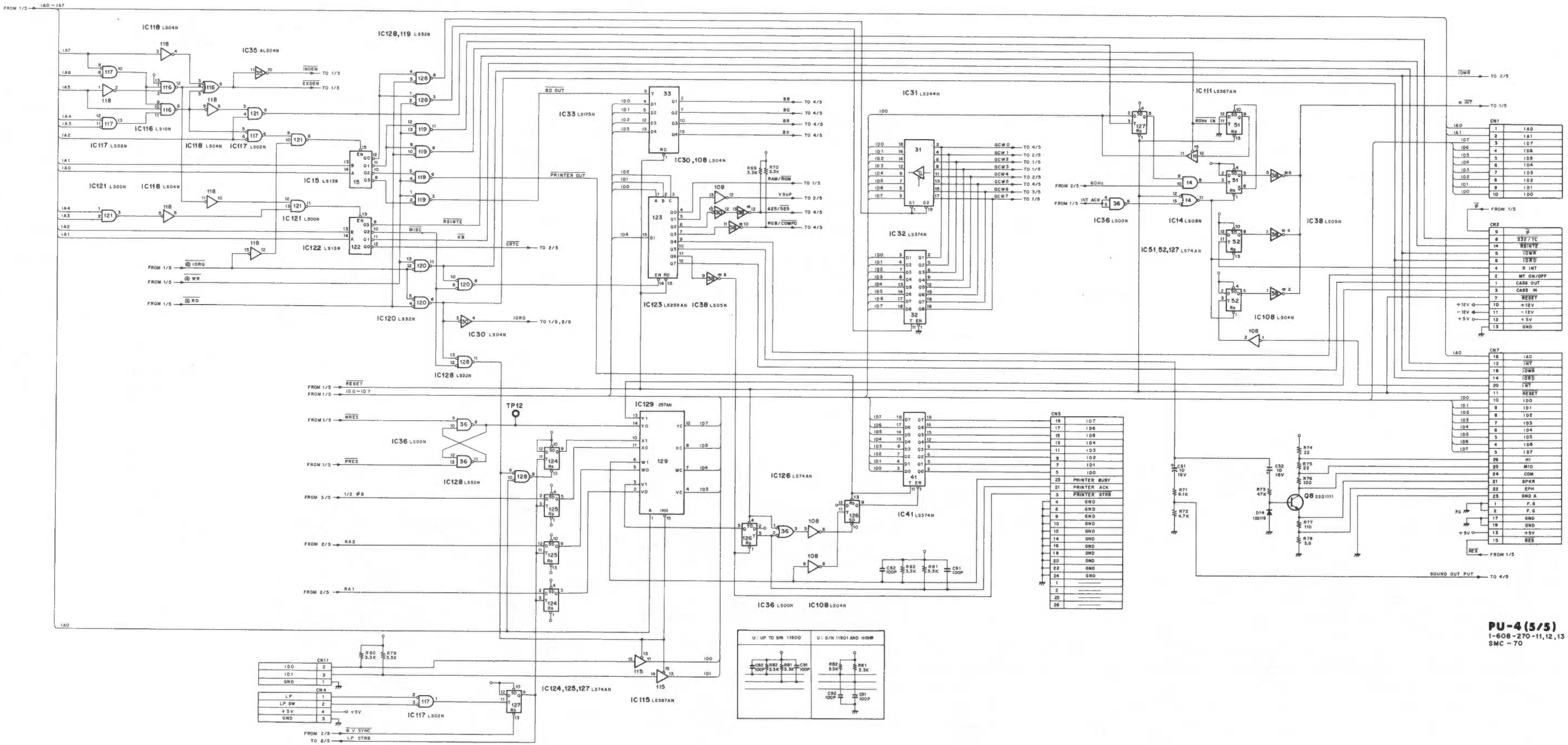
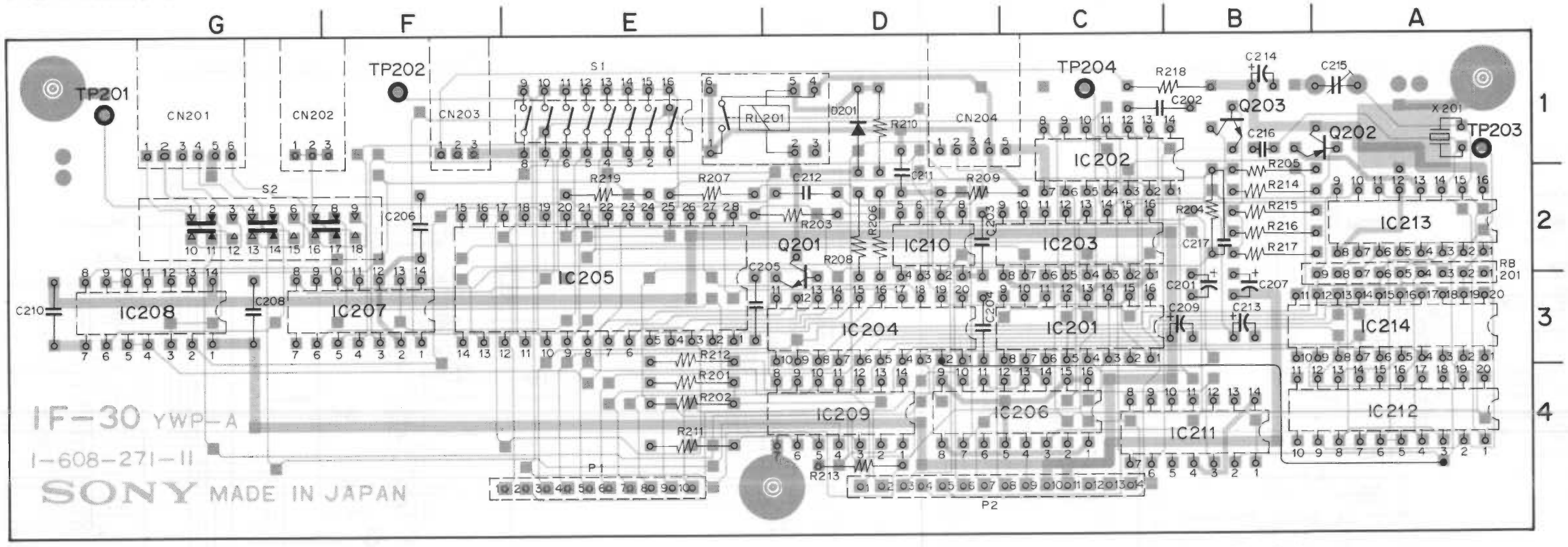
PU-4 (MAIN BOARD)4/5



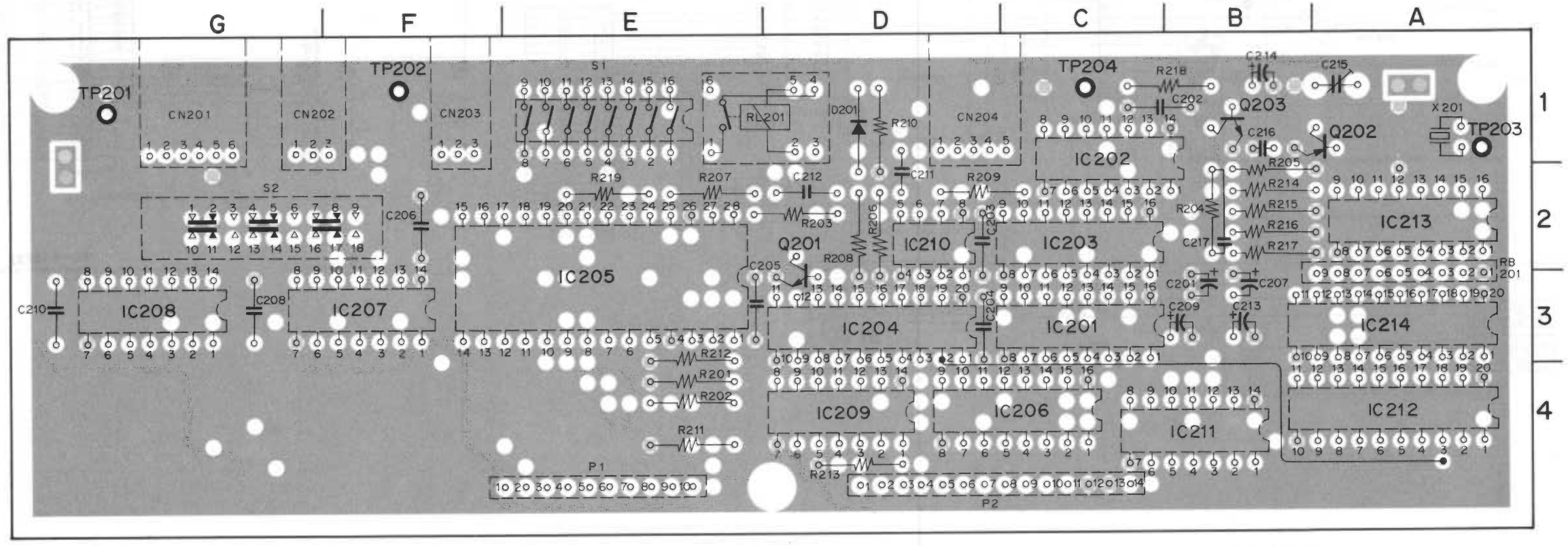


PU-4 (5/5)
1-608-270-11,12,13
SMC – 70

IF-30 (SUB BOARD) S/N 10001 TO 10800



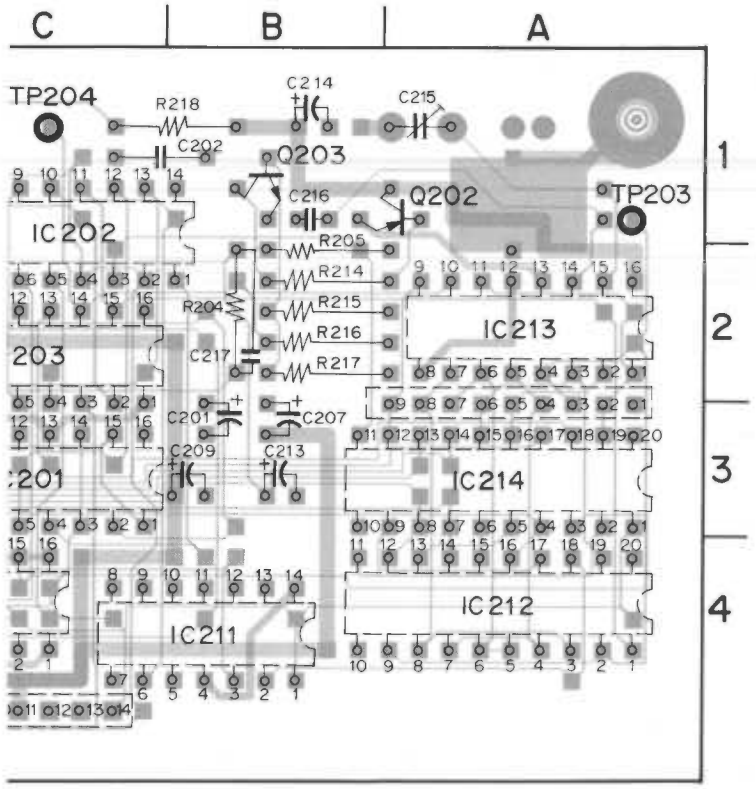
IF-30 — SOLDERING SIDE —
1-608-271-11
SMC-70



IF-30 — SOLDERING SIDE —
1-608-271-11
SMC-70

C201	B - 3		R201	E - 4	
C202	C - 1		R202	E - 4	
C203	D - 2		R203	D - 2	
C204	D - 3		R204	B - 2	
C205	E - 3		R205	B - 2	
C206	F - 2		R206	D - 2	
C207	B - 3		R207	E - 2	
C208	G - 3		R208	D - 2	
C209	B - 3		R209	D - 2	
C210	G - 3		R210	D - 1	
C211	D - 2		R211	E - 4	
C212	D - 2		R212	E - 3	
C213	B - 3		R213	D - 4	
C214	B - 1		R214	B - 2	
C215	A - 1		R215	B - 2	
C216	B - 1		R216	B - 2	
			R217	B - 2	
D201	D - 1		R218	B - 1	
			R219	E - 2	
IC201	C - 3				
IC202	C - 1		RL201	E - 1	
IC203	C - 2				
IC204	D - 3		RY201	D - 1	
IC205	E - 2				
IC206	C - 4		SW1	E - 1	
IC207	F - 3		SW2	G - 2	
IC208	G - 3				
IC209	D - 4		TP201	G - 1	
IC210	D - 2		TP202	F - 1	
IC211	B - 4		TP203	A - 1	
IC212	A - 4		TP204	C - 1	
IC213	A - 2				
IC214	A - 3		X201	A - 1	
P1	E - 4				
P2	D - 4				
Q201	D - 2				
Q202	A - 1				
Q203	B - 1				

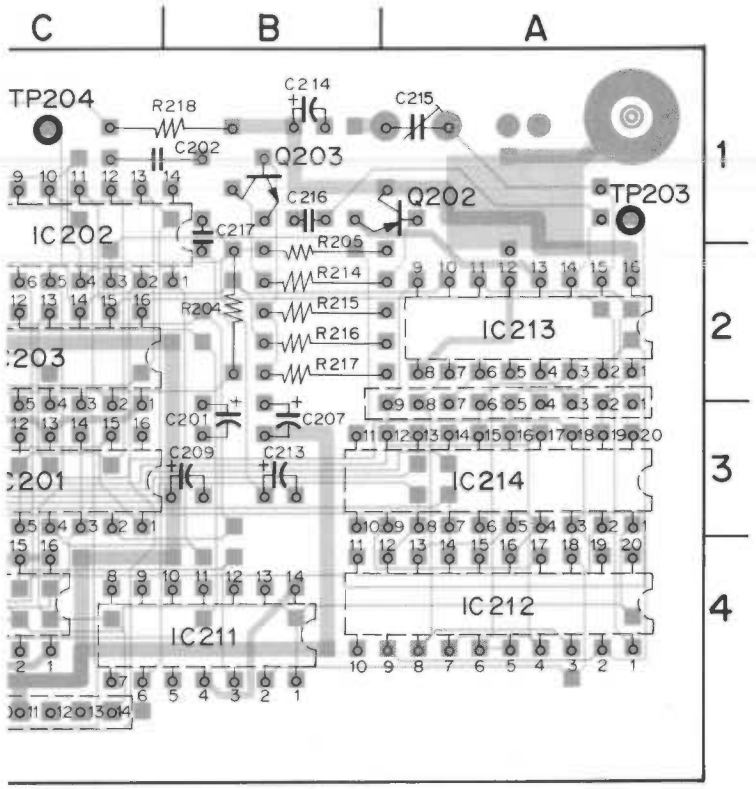
S/N 10801 TO 11900



IF-30 — SOLDERING SIDE—
1-608-271-12
SMC-70

C201	B - 3	R201	E - 4		
C202	C - 1	R202	E - 4		
C203	D - 2	R203	D - 2		
C204	D - 3	R204	B - 2		
C205	E - 3	R205	B - 2		
C206	F - 2	R206	D - 2		
C207	B - 3	R207	E - 2		
C208	G - 3	R208	D - 2		
C209	B - 3	R209	D - 2		
C210	G - 3	R210	D - 1		
C211	D - 2	R211	E - 4		
C212	D - 2	R212	E - 3		
C213	B - 3	R213	D - 4		
C214	B - 1	R214	B - 2		
C215	A - 1	R215	B - 2		
C216	B - 1	R216	B - 2		
		R217	B - 2		
D201	D - 1	R218	B - 1		
		R219	E - 2		
IC201	C - 3				
IC202	C - 1	RL201	E - 1		
IC203	C - 2				
IC204	D - 3	RY201	D - 1		
IC205	E - 2				
IC206	C - 4	SW1	E - 1		
IC207	F - 3	SW2	G - 2		
IC208	G - 3				
IC209	D - 4	TP201	G - 1		
IC210	D - 2	TP202	F - 1		
IC211	B - 4	TP203	A - 1		
IC212	A - 4	TP204	C - 1		
IC213	A - 2				
IC214	A - 3	X201	A - 1		
P1	E - 4				
P2	D - 4				
Q201	D - 2				
Q202	A - 1				
Q203	B - 1				

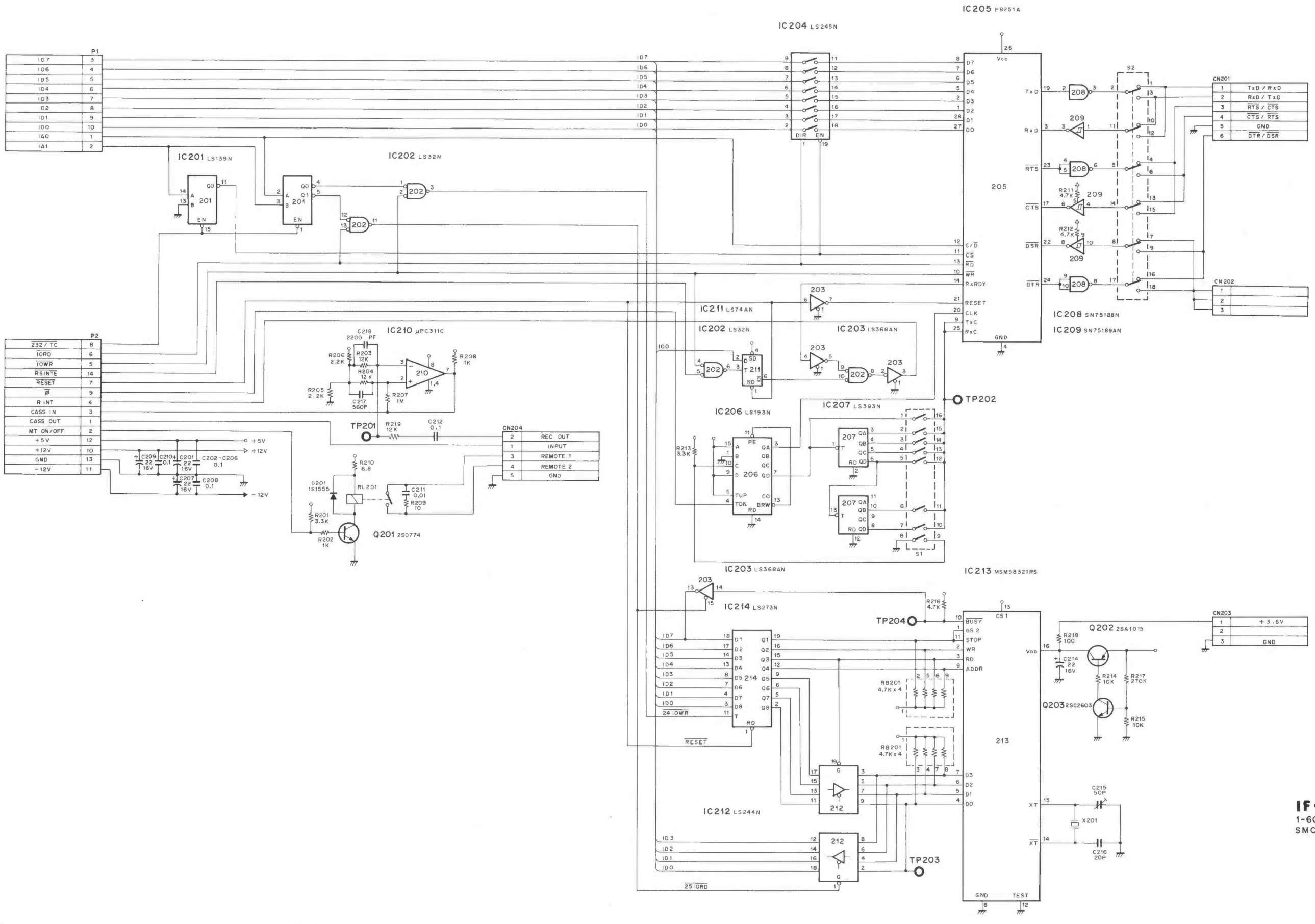
S/N 11901 AND HIGHER



IF-30 — SOLDERING SIDE—
1-608-271-13
SMC-70

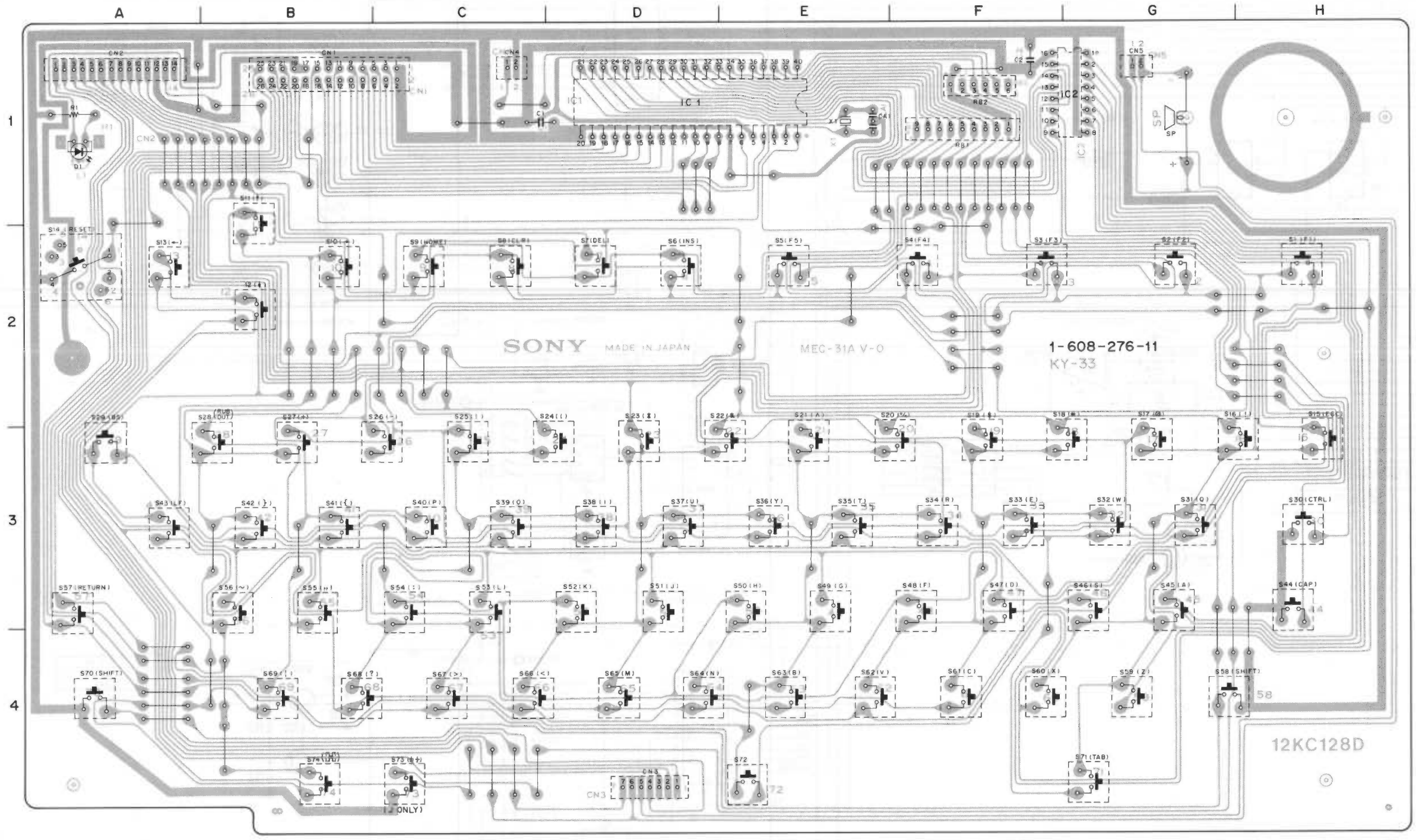
C201	B - 3	R201	E - 4		
C202	C - 1	R202	E - 4		
C203	D - 2	R203	D - 2		
C204	D - 3	R204	B - 2		
C205	E - 3	R205	B - 2		
C206	F - 2	R206	D - 2		
C207	B - 3	R207	E - 2		
C208	G - 3	R208	D - 2		
C209	B - 3	R209	D - 2		
C210	G - 3	R210	D - 1		
C211	D - 2	R211	E - 4		
C212	D - 2	R212	E - 3		
C213	B - 3	R213	D - 4		
C214	B - 1	R214	B - 2		
C215	A - 1	R215	B - 2		
C216	B - 1	R216	B - 2		
		R217	B - 2		
D201	D - 1	R218	B - 1		
		R219	E - 2		
IC201	C - 3				
IC202	C - 1	RL201	E - 1		
IC203	C - 2				
IC204	D - 3	RY201	D - 1		
IC205	E - 2				
IC206	C - 4	SW1	E - 1		
IC207	F - 3	SW2	G - 2		
IC208	G - 3				
IC209	D - 4	TP201	G - 1		
IC210	D - 2	TP202	F - 1		
IC211	B - 4	TP203	A - 1		
IC212	A - 4	TP204	C - 1		
IC213	A - 2				
IC214	A - 3	X201	A - 1		
P1	E - 4				
P2	D - 4				
Q201	D - 2				
Q202	A - 1				
Q203	B - 1				

IF-30 (SUB BOARD)



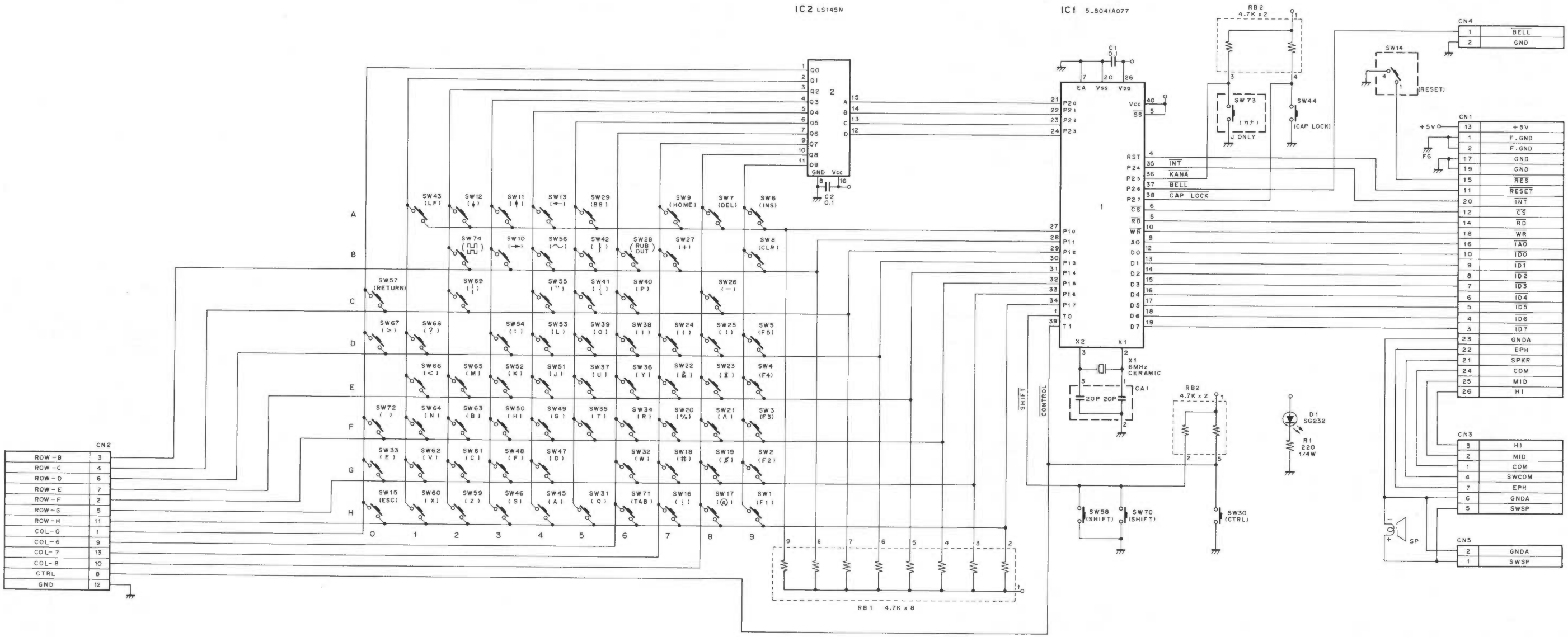
IF-30
1-608-271-11,12,13
SMC-70

KY-33 (KEY BOARD)



C1	C - 1	SW41	B - 3
C2	F - 1	SW42	B - 3
		SW43	A - 3
CA1	E - 1	SW44	H - 3
		SW45	G - 3
CN1	B - 1	SW46	G - 3
CN2	A - 1	SW47	F - 3
CN3	D - 4	SW48	F - 3
CN4	C - 1	SW49	E - 3
CN5	G - 1	SW50	E - 3
		SW51	D - 3
IC1	D - 1	SW52	D - 3
IC2	G - 1	SW53	C - 3
		SW54	C - 3
L1	A - 1	SW55	B - 3
		SW56	B - 3
R1	A - 1	SW57	A - 3
		SW58	G - 4
RB1	F - 1	SW59	G - 4
RB2	F - 1	SW60	F - 4
		SW61	F - 4
SP	G - 1	SW62	E - 4
		SW63	E - 4
SW1	H - 2	SW64	D - 4
SW2	G - 2	SW65	D - 4
SW3	F - 2	SW66	C - 4
SW4	F - 2	SW67	C - 4
SW5	E - 2	SW68	B - 4
SW6	D - 2	SW69	B - 4
SW7	D - 2	SW70	A - 4
SW8	C - 2	SW71	G - 4
SW9	C - 2	SW72	E - 4
SW10	B - 2	SW73	C - 4
SW11	B - 1	SW74	B - 4
SW12	B - 2		
SW13	A - 2	X1	E - 1
SW14	A - 2		
SW15	H - 3		
SW16	H - 3		
SW17	G - 3		
SW18	G - 3		
SW19	F - 3		
SW20	F - 3		
SW21	E - 3		
SW22	E - 3		
SW23	D - 3		
SW24	D - 3		
SW25	C - 3		
SW26	C - 3		
SW27	B - 3		
SW28	B - 3		
SW29	A - 3		
SW30	H - 3		
SW31	G - 3		
SW32	G - 3		
SW33	F - 3		
SW34	F - 3		
SW35	E - 3		
SW36	E - 3		
SW37	D - 3		
SW38	D - 3		
SW39	C - 3		
SW40	C - 3		

KY-33 (KEY BOARD)

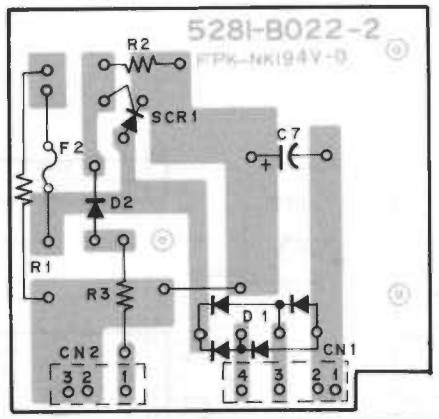


KY-33

SMC-70

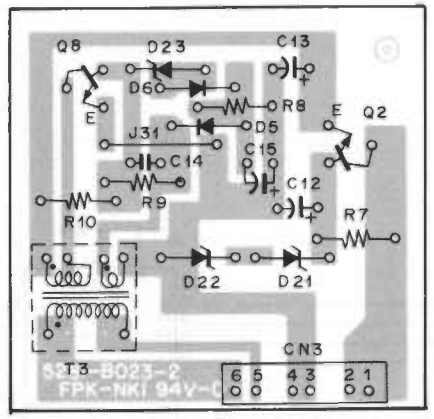
PK-1, PK-2, PK-3, PK-4, PK-5, PK-6 (POWER SUPPLY)

PK-1



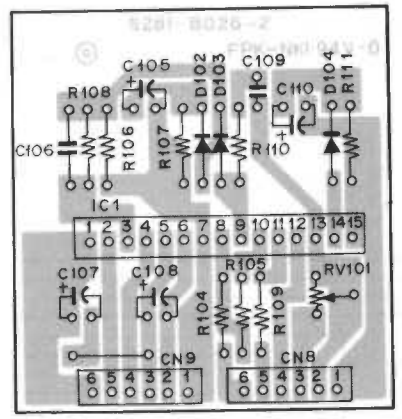
PK-1-SOLDERING SIDE-
SMC-70

PK-2



PK-2 - SOLDERING SIDE-
SMC-70

PK-5



PK-5 - SOLDERING SIDE-
SMC-70

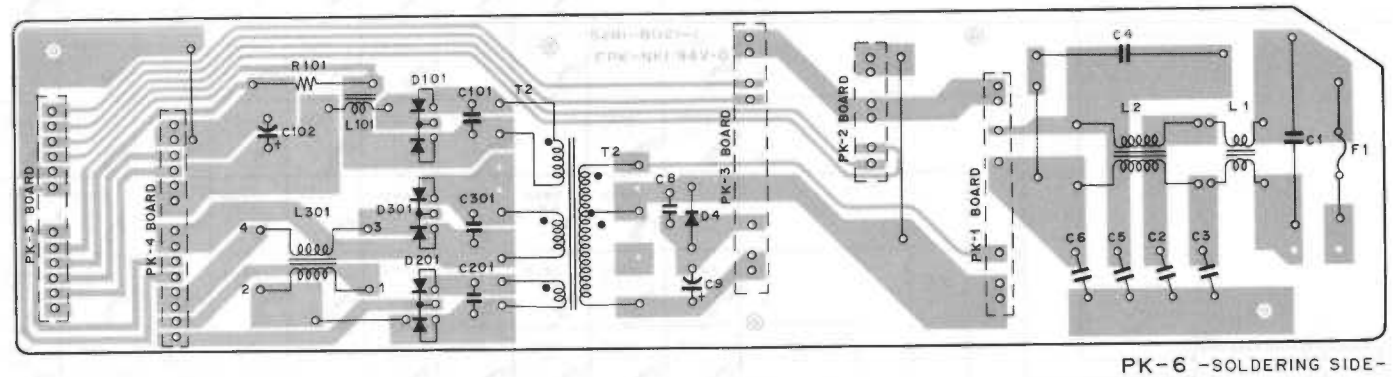
PK-3

PK-3 - SOLDERING SIDE-
SMC-70

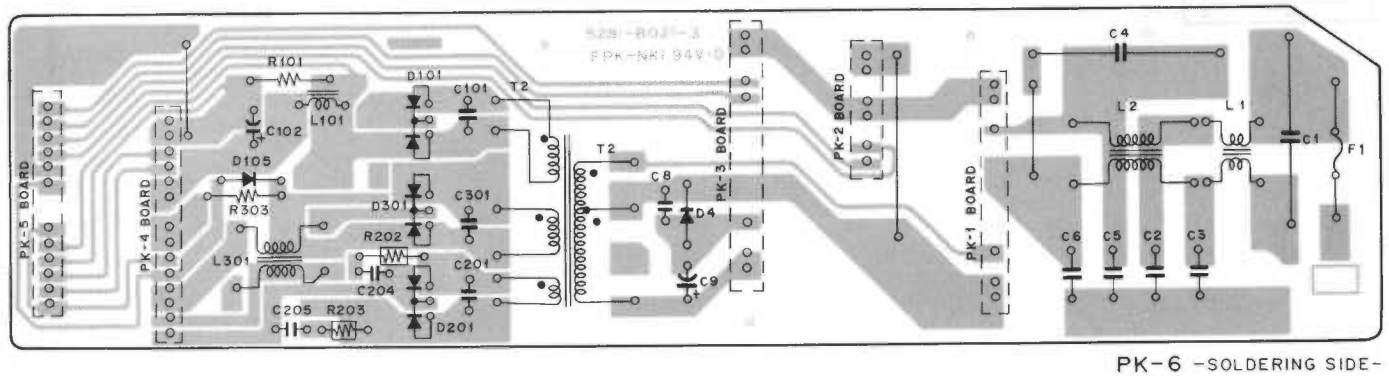
PK-4

PK-4 - SOLDERING SIDE-
SMC-70

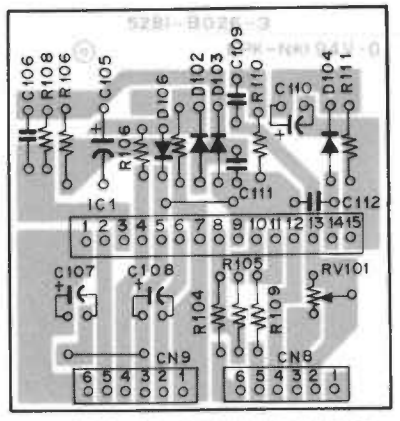
PK-6



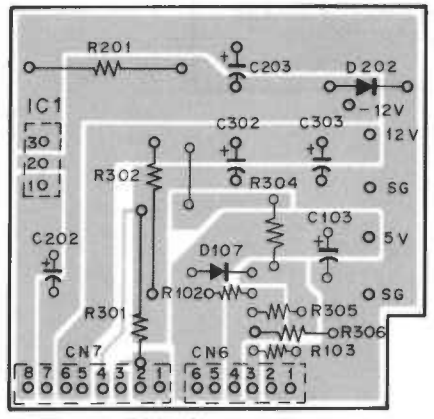
PK-6 - SOLDERING SIDE-
SMC-70



PK-6 - SOLDERING SIDE-
SMC-70

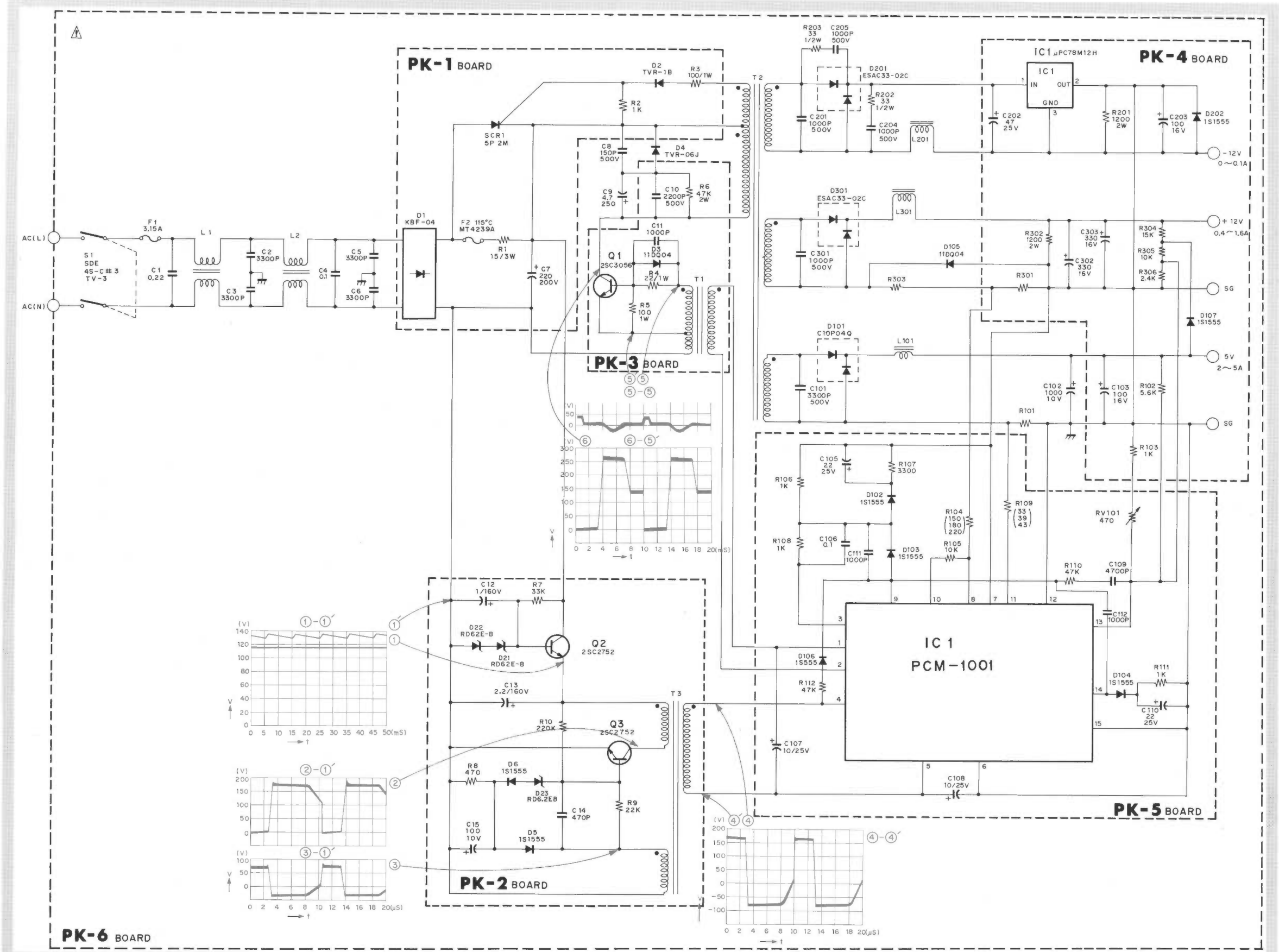


PK-5 - SOLDERING SIDE-
SMC-70

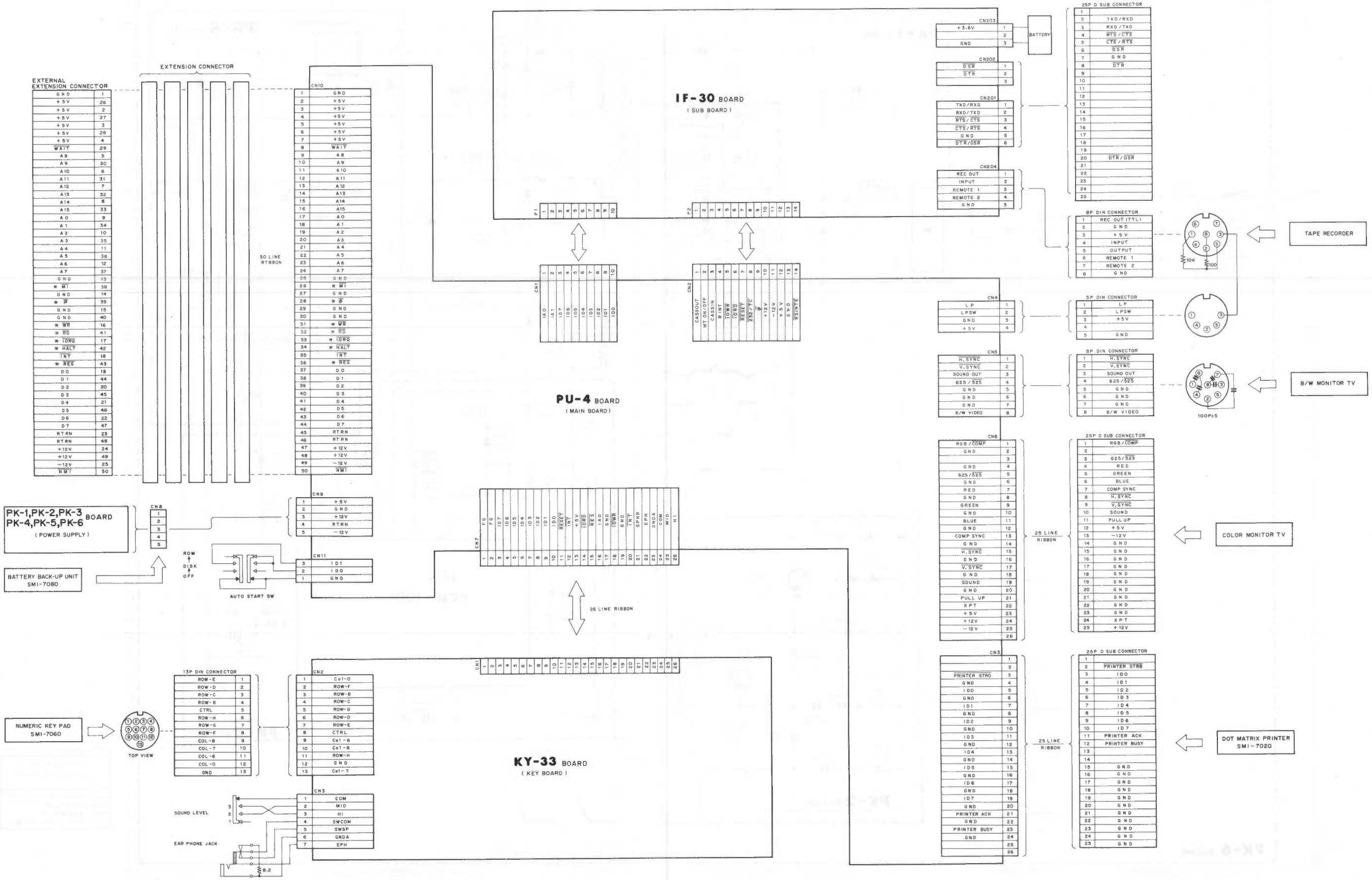


PK-4 - SOLDERING SIDE-
SMC-70

PK-1, PK-2, PK-3, PK-4, PK-5, PK-6 (POWER SUPPLY)



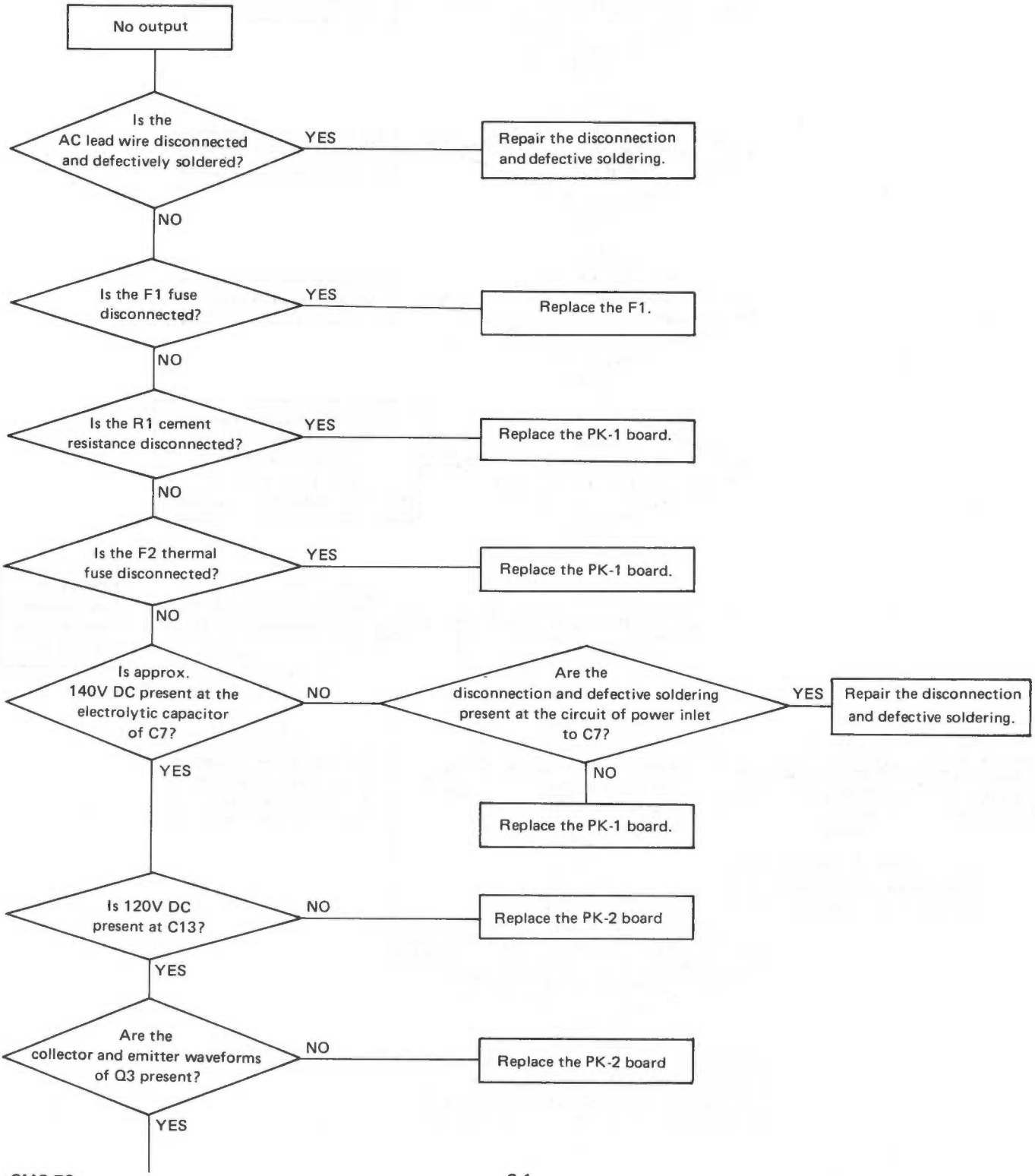
FRAME WIRING

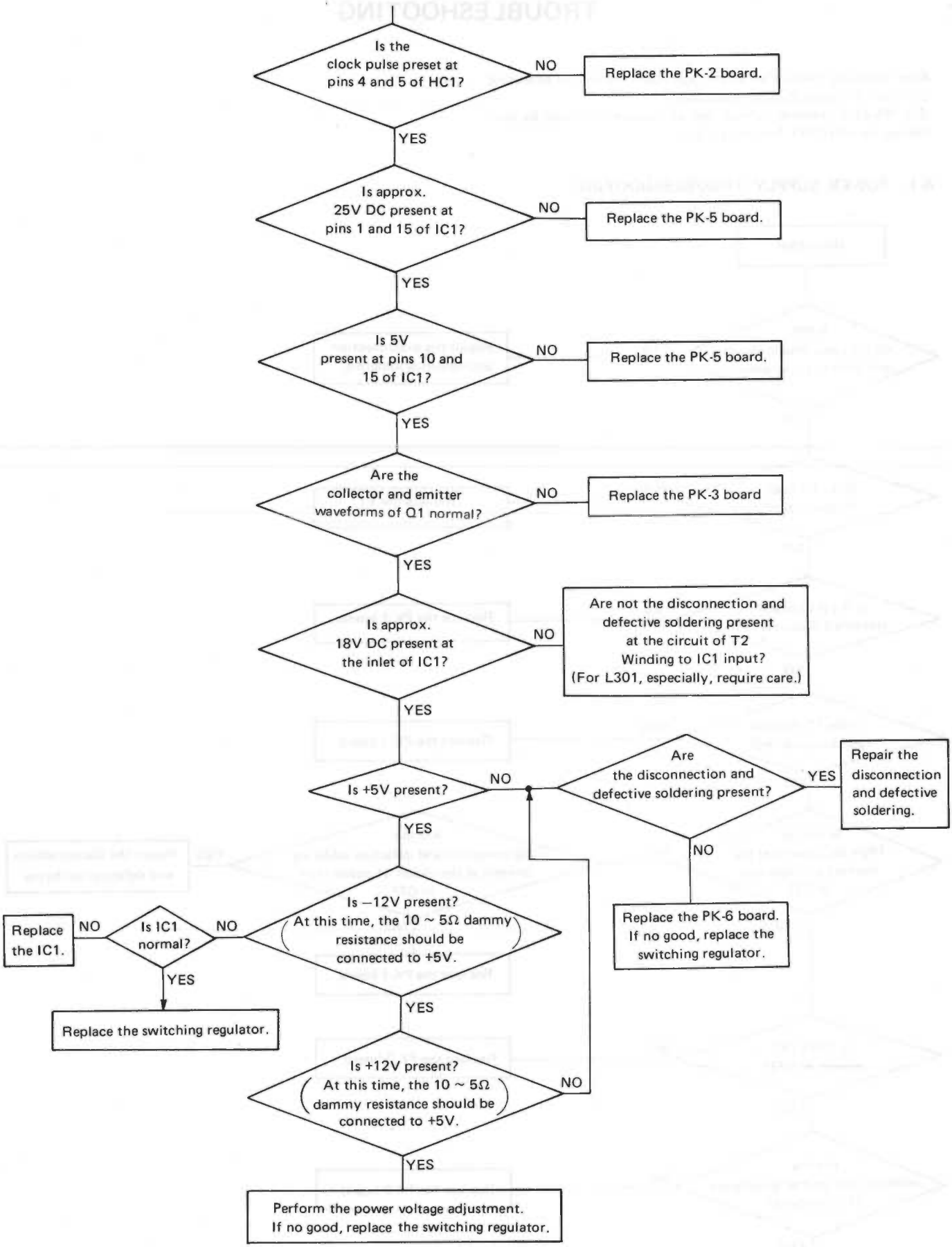


SECTION 6
TROUBLESHOOTING

After repairing, check that all the operations are OK by executing the diagnostic Level 2 (refer to Section 7).
(For RS-232C, however, check that all operates normally by connecting the SMI-7031, finished goods.)

6-1. POWER SUPPLY TROUBLESHOOTING



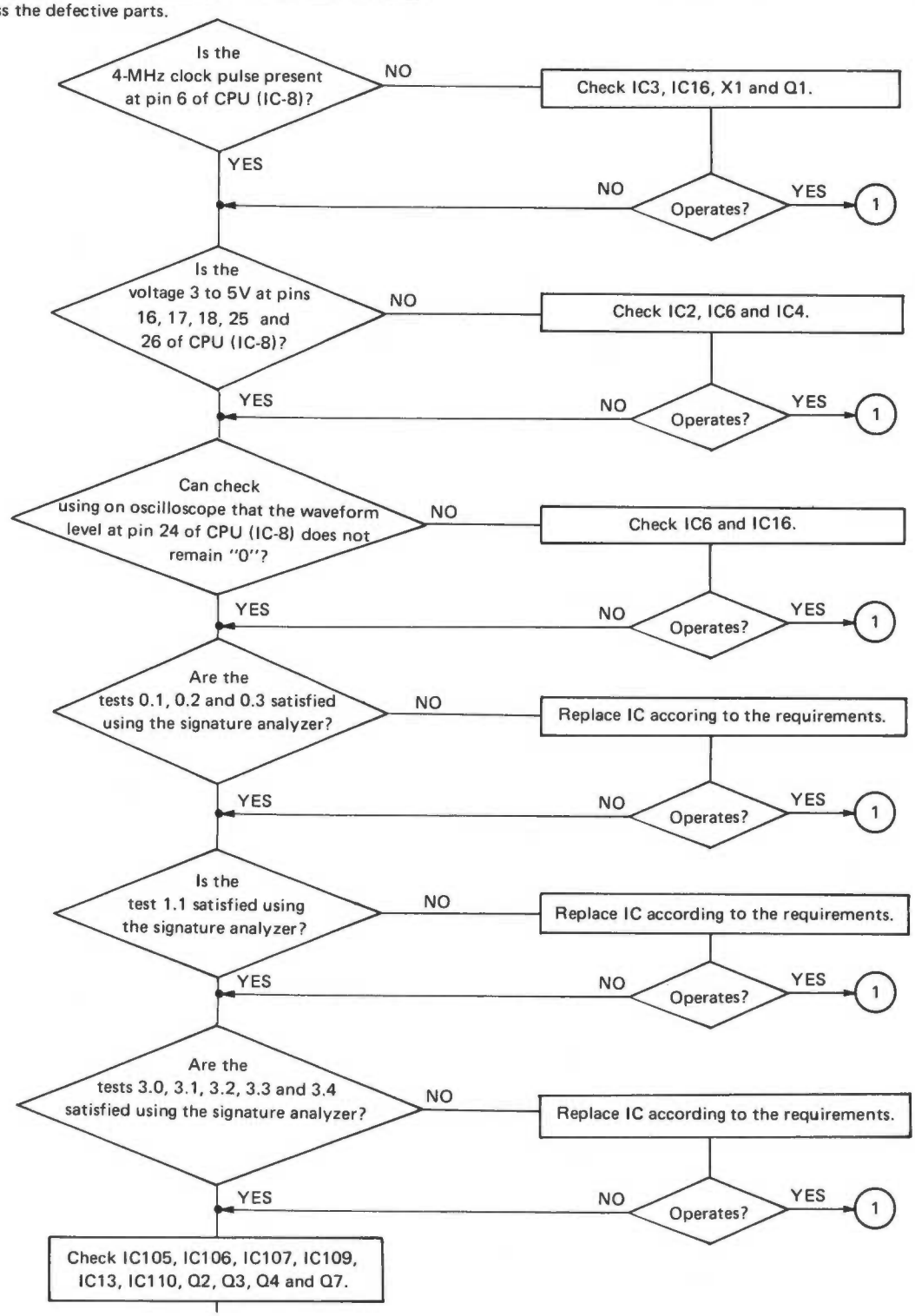

Is the clock pulse preset at pins 4 and 5 of HC1?
NO
Replace the PK-2 board.
YES
Is approx. 25V DC present at pins 1 and 15 of IC1?
NO
Replace the PK-5 board.
YES
Is 5V present at pins 10 and 15 of IC1?
NO
Replace the PK-5 board.
YES
Are the collector and emitter waveforms of Q1 normal?
NO
Replace the PK-3 board
YES
Is approx. 18V DC present at the inlet of IC1?
NO
Are not the disconnection and defective soldering present at the circuit of T2 Winding to IC1 input? (For L301, especially, require care.)
YES
Is +5V present?
NO
Are the disconnection and defective soldering present?
YES
Repair the disconnection and defective soldering.
NO
Replace the PK-6 board. If no good, replace the switching regulator.
YES
Is −12V present? At this time, the 10 ~ 5Ω dammy resistance should be connected to +5V.
NO
Is IC1 normal?
NO
Replace the IC1.
YES
Replace the switching regulator.
YES
Is +12V present? At this time, the 10 ~ 5Ω dammy resistance should be connected to +5V.
NO
YES
Perform the power voltage adjustment. If no good, replace the switching regulator.

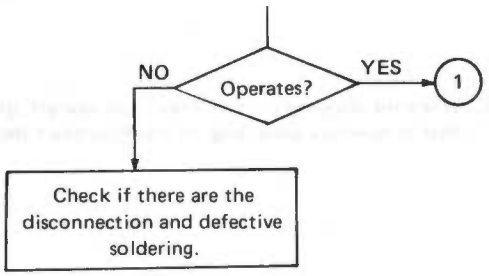
6-2. TROUBLESHOOTING EXCEPT FOR POWER SUPPLY

① Operate the diagnostic Level 2 (refer to Section 7) to recognize the defective points in the block level (CRT CHECK, PRINTER CHECK, etc.).

② According to the contents of the defective points, execute the required signature analyzer test (refer to Section 8) (ROM-B test, INTERNAL I/O WRITE test, etc.), and then recognize and process the defective parts.

③ When the diagnostic Level 2 does not operate, process them so that it operates according to the flow chart described below.




NO
Operates?
YES
1
Check if there are the disconnection and defective soldering.

SECTION 7
DIAGNOSTICS

Outline

SMC-70 has four kinds of self-diagnostic functions.

1. Level 0

Level 0 checks are performed automatically by the system monitor after switching on.

2. Level 1

Level 1 is a command for check use among the commands which are incorporated into System Monitor.
Q COMMAND
Y COMMAND
R COMMAND
J COMMAND

3. Level 2

Level 2 checks are performed by running the program by means of the disk drive. 11 different checks can be performed as shown below (B~T).
This will be sold to end users. { SMW-7002 (CP/M OPERATING SYSTEM) }

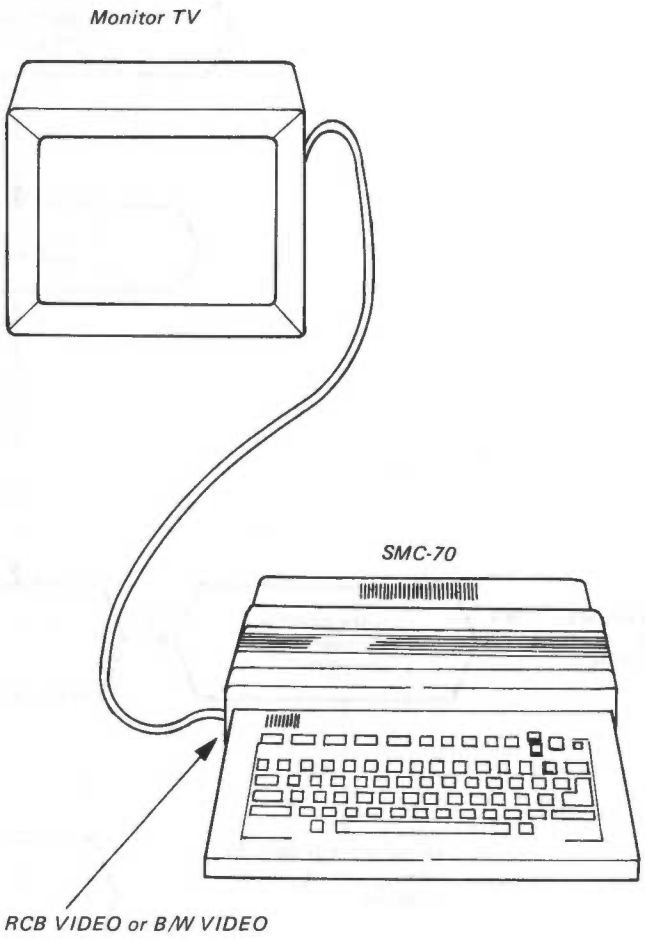
```
SMC-70 DIAGNOSTICS

     A : ALL DEVICE CHECK
     B : BEEP CHECK
     C : CRT CHECK
     D : DISK CHECK
     E : CACHE DISK CHECK
     I : IEEE-488 CHECK
     K : KEYBOARD/TEN KEY CHECK
     L : LIGHT PEN CHECK
     M : MEMORY CHECK
     P : PRINTER CHECK
     S : TAPE CASSETTE CHECK
     T : TIMER CHECK
   ESC : END
```

4. Service Diagnostics

For service people only.
To get further information please contact Sony america.

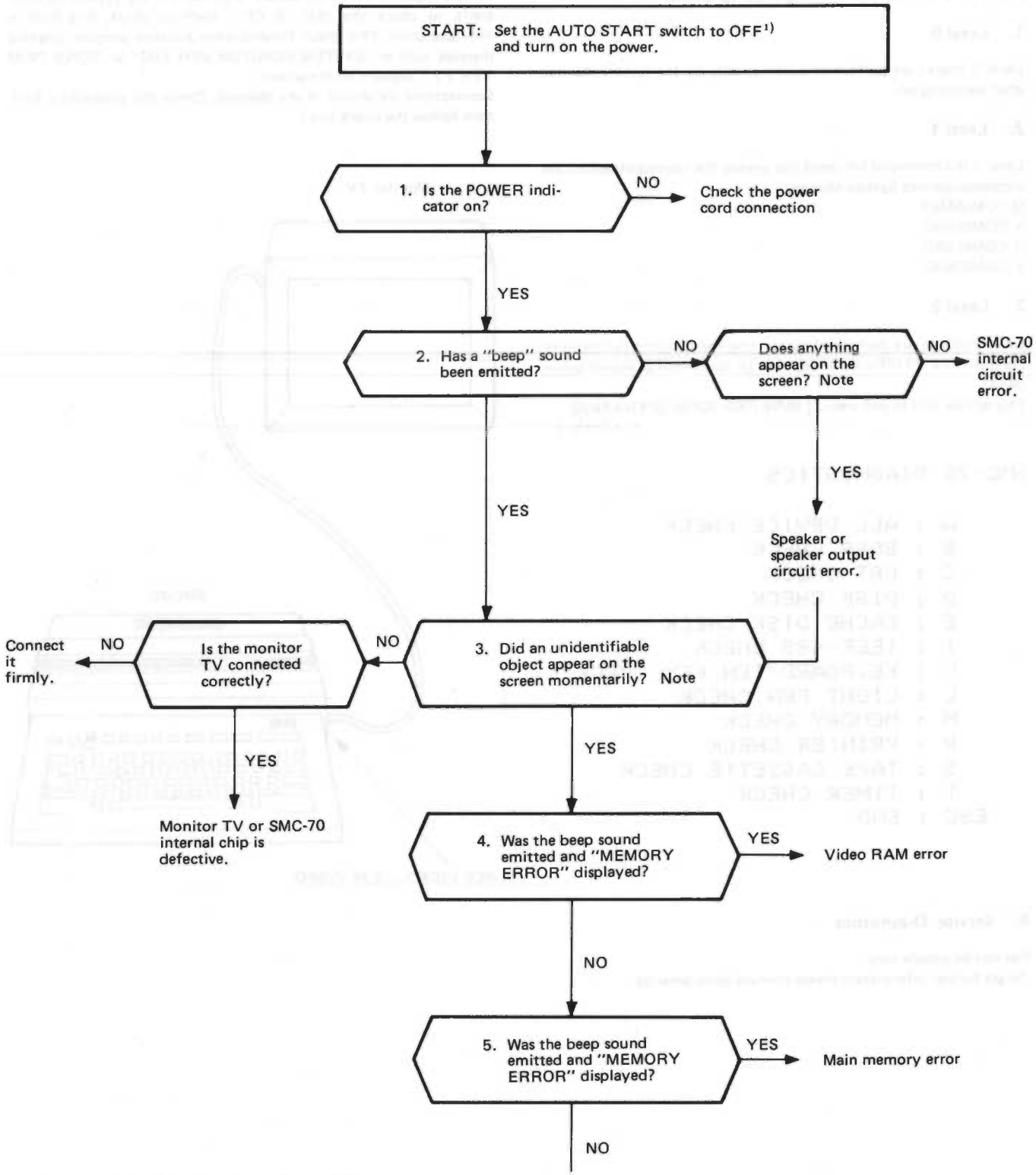
7-1. DIAGNOSTICS LEVEL 0

At the moment when the power is turned on, the system monitor starts to check the SMC-70 CPU, memory chips, and built-in interface chips. This check finishes when a system program opening message, such as "SYSTEM MONITOR VER 1.00" or "SONY CP/M VER 2.2", appears on the screen.
Connections are shown in the diagram. Check the connection first, then follow the check chart.

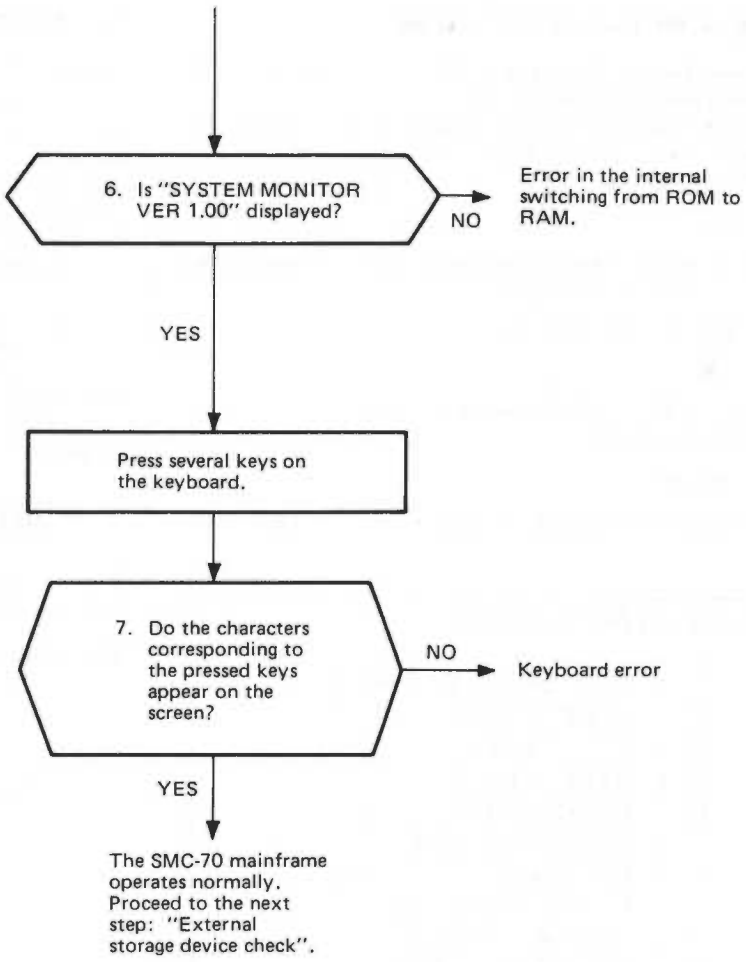


CHECK CHART

First of all, turn on the monitor TV.


START: Set the AUTO START switch to OFF[1)] and turn on the power.
1. Is the POWER indicator on?
NO
Check the power cord connection
YES
2. Has a "beep" sound been emitted?
NO
Does anything appear on the screen? Note
NO
SMC-70 internal circuit error.
YES
YES
Speaker or speaker output circuit error.
3. Did an unidentifiable object appear on the screen momentarily? Note
NO
Is the monitor TV connected correctly?
NO
Connect it firmly.
YES
Monitor TV or SMC-70 internal chip is defective.
YES
4. Was the beep sound emitted and "MEMORY ERROR" displayed?
YES
Video RAM error
NO
5. Was the beep sound emitted and "MEMORY ERROR" displayed?
YES
Main memory error
NO

Note: When the SMC-70 and monitor TV are turned on at the same time, nothing appear for a while on the screen. Therefore, notice that this pattern may not appear.


6. Is "SYSTEM MONITOR VER 1.00" displayed?
NO
Error in the internal switching from ROM to RAM.
YES
Press several keys on the keyboard.
7. Do the characters corresponding to the pressed keys appear on the screen?
NO
Keyboard error
YES
The SMC-70 mainframe operates normally. Proceed to the next step: "External storage device check".

When the AUTO START switch is set to DISK or ROM, you can check in the same way as above up to step 5. Step 6 and subsequent steps, however, are carried out by the activated program. When a system program opening message, such as "SONY CP/M 2.2", etc. is displayed, the system may be started up normally. Check the keyboard operation by pressing several keys.

Loading of the program for checking

The program for the Diagnostics Level 2 can be supplied through the system disk of the floppydisk unit.
How to load the program from a floppydisk. Load the system disk onto the A-drive of the disk unit and while the system monitor is in command waiting status, input:

```
>C↵
```

Or, turn the AUTO START switch placed on the left side panel to "DISK" and press the reset button.

```
SONY CP/M VER 2.2
A>■
```

The screen will show the above and the CP/M starts.
Under this status, input:

```
A>DIAG↵
```

Then the screen will show the above and the self-check program starts.

```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK
    B : BEEP CHECK
    C : CRT CHECK
    D : DISK CHECK
    E : CACHE DISK CHECK
    I : IEEE-488 CHECK
    K : KEYBOARD/TEN KEY CHECK
    L : LIGHT PEN CHECK
    M : MEMORY CHECK
    P : PRINTER CHECK
    S : TAPE CASSETTE CHECK
    T : TIMER CHECK
  ESC : END

  COMMAND ? ■
```

7-2. DIAGNOSTICS LEVEL 1

Outline

LEVEL 1 is not an exclusive program for diagnostics.
This is a command for check use in the system monitor commands. Therefore, at any time the LEVEL 1 check is executed by calling the system monitor.
The commands corresponding to LEVEL 1 are Q, Y, R and J COMMANDS.

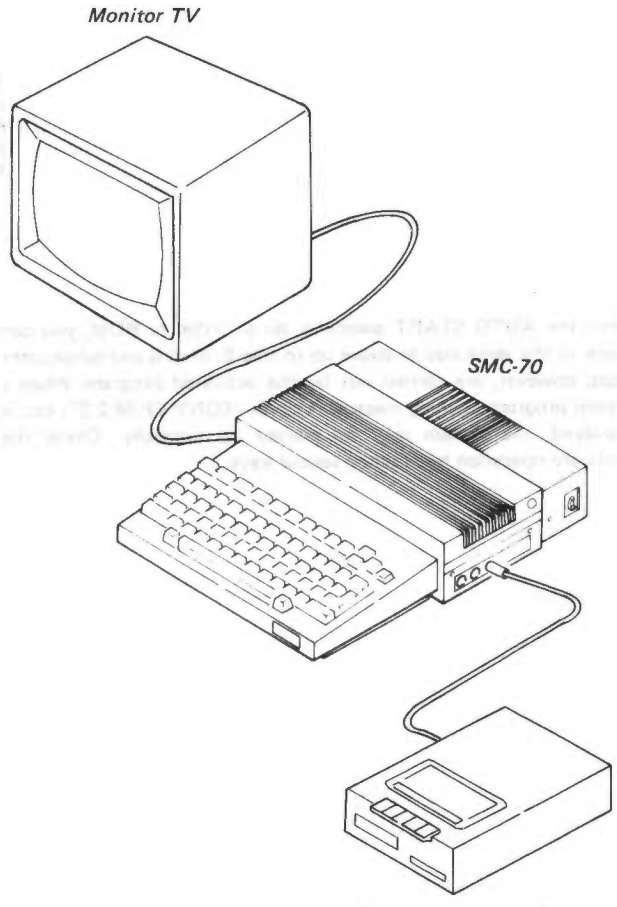
- Q COMMAND (QD: DISK CHECK)
  (QS: TAPE RECORDER CHECK)
- Y COMMAND (Y: TIMER CHECK)
- R COMMAND (R: ROM PACK CHECK)
- J COMMAND (J: RAM, VIDEO RAM CHECK)

Refer to System Monitor Manual for the description of these COMMANDS. Here, respective using methods are described based a Diagnostics.

TAPE RECORDER CHECK

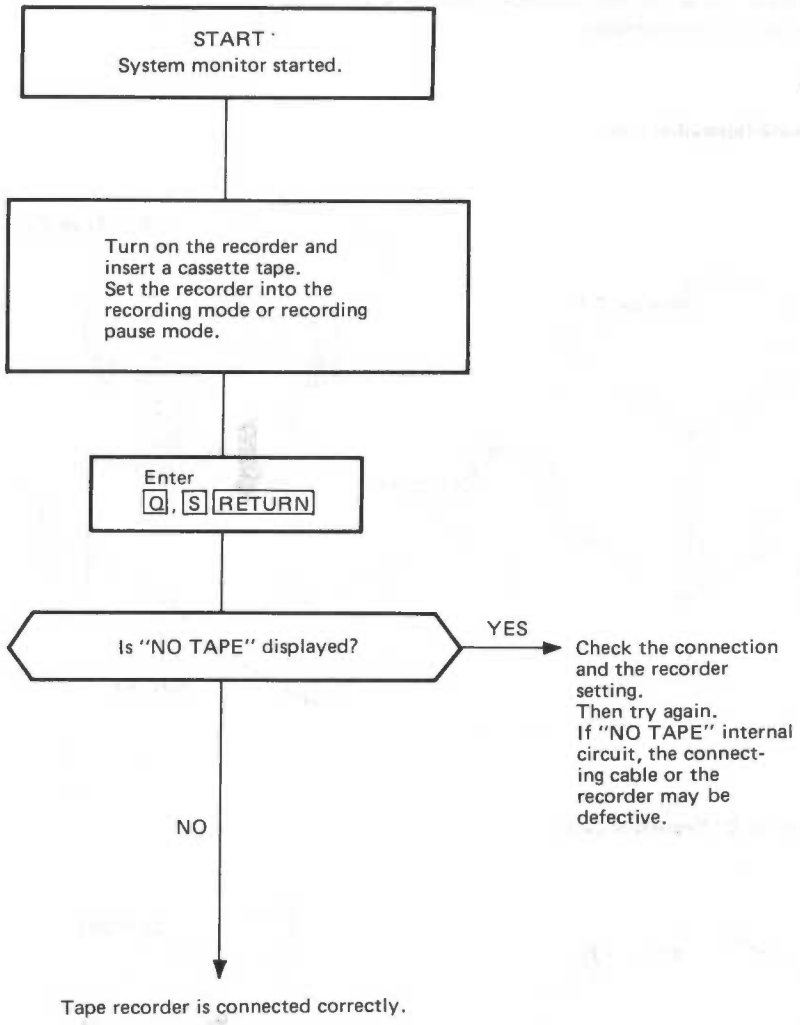
You can check the connection of the tape recorder, using the command QS of the system monitor.

Connection



Cassette tape recorder

Check chart


START
System monitor started.
Turn on the recorder and insert a cassette tape. Set the recorder into the recording mode or recording pause mode.
Enter
Q, S RETURN
Is "NO TAPE" displayed?
YES
Check the connection and the recorder setting.
Then try again.
If "NO TAPE" internal circuit, the connecting cable or the recorder may be defective.
NO
Tape recorder is connected correctly.

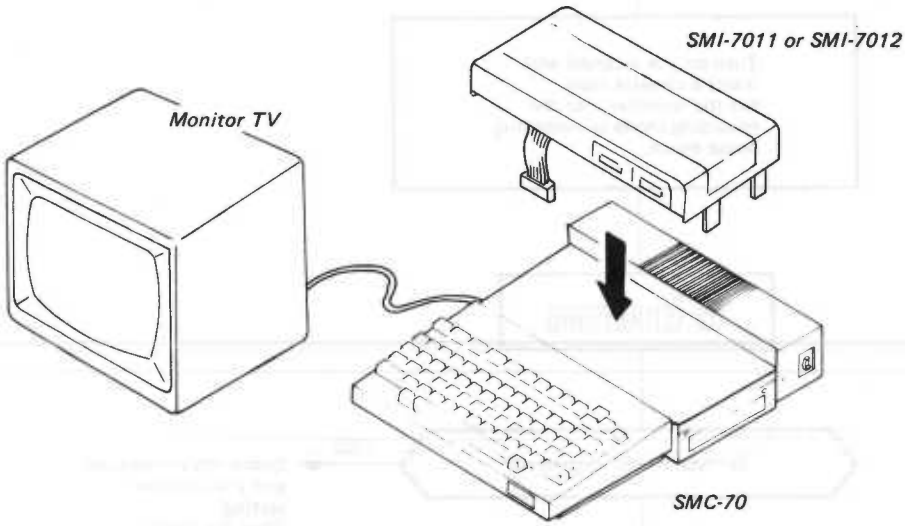
Note: In REC mode, the input data is output from "ear", so check that the connection is correctly performed.

DISK CHECK

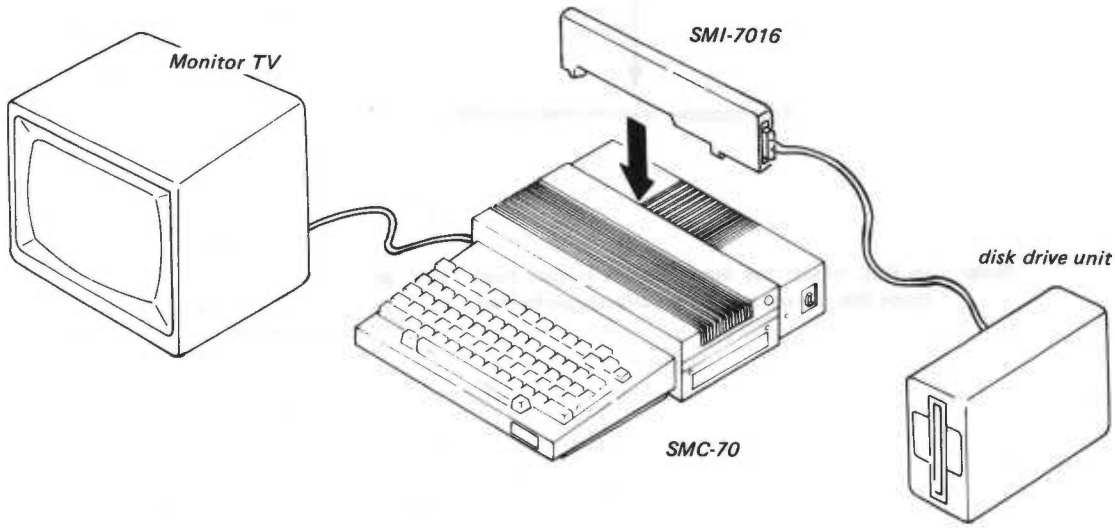
The command QD makes the read operation check of a disk drive unit specified as the A drive possible.

Connection

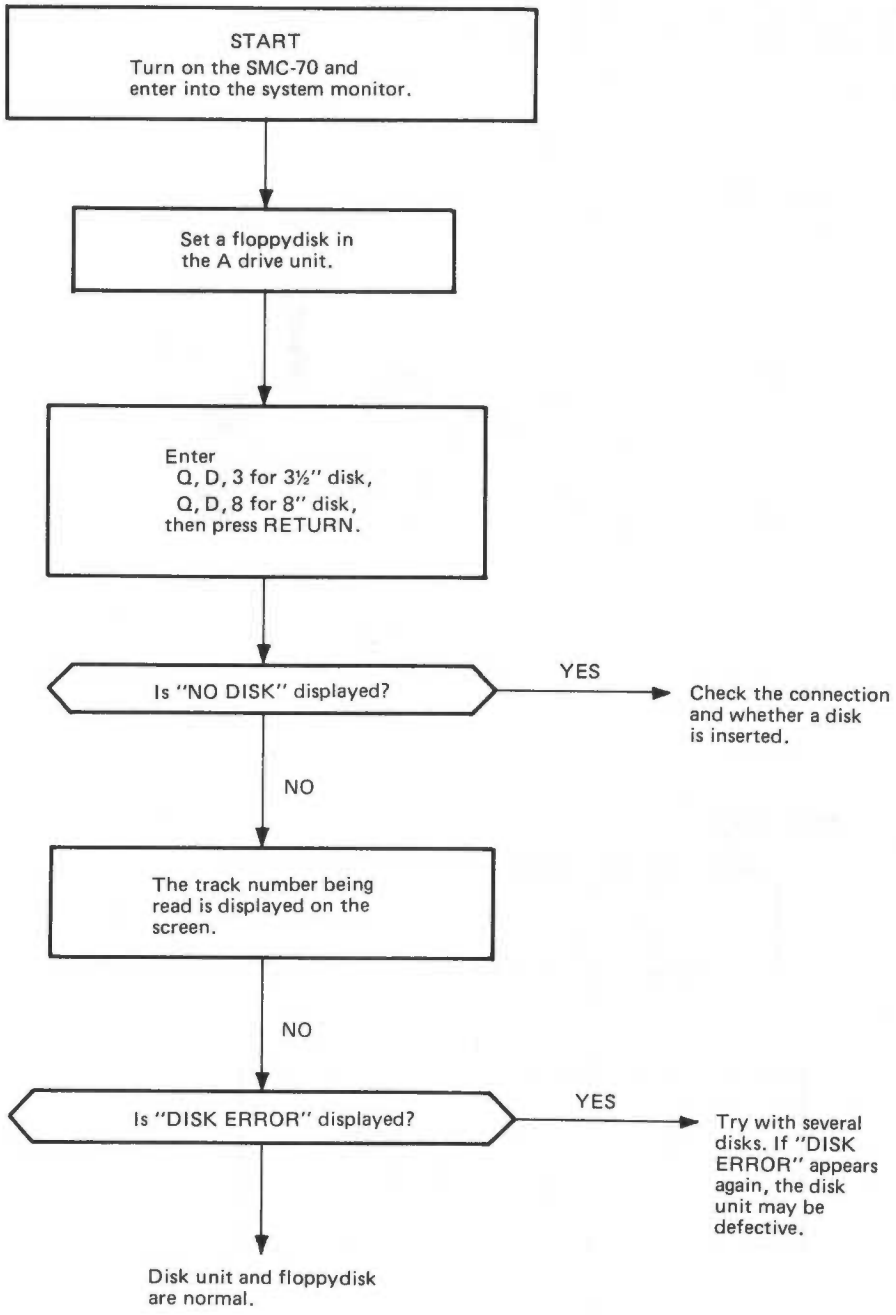
To check a micro floppydisk unit



To check a 5¼" or 8" floppydisk unit



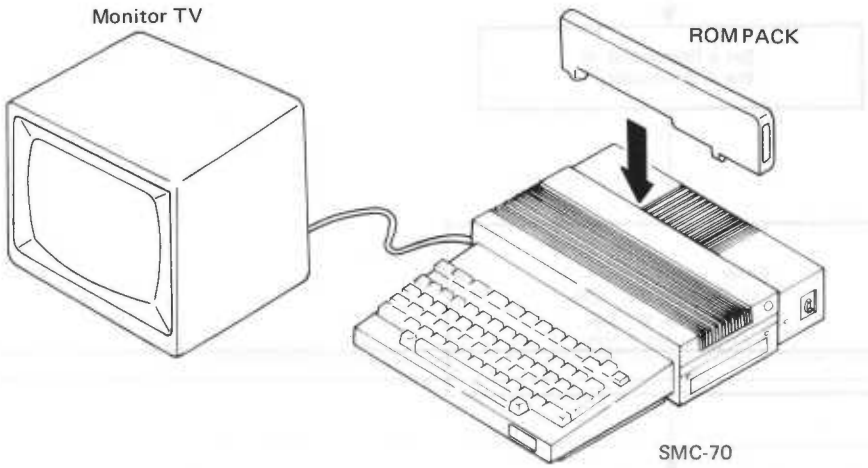
Check chart


START
Turn on the SMC-70 and enter into the system monitor.
Set a floppydisk in the A drive unit.
Enter
Q, D, 3 for 3½" disk,
Q, D, 8 for 8" disk,
then press RETURN.
Is "NO DISK" displayed?
YES
Check the connection and whether a disk is inserted.
NO
The track number being read is displayed on the screen.
NO
Is "DISK ERROR" displayed?
YES
Try with several disks. If "DISK ERROR" appears again, the disk unit may be defective.
Disk unit and floppydisk are normal.

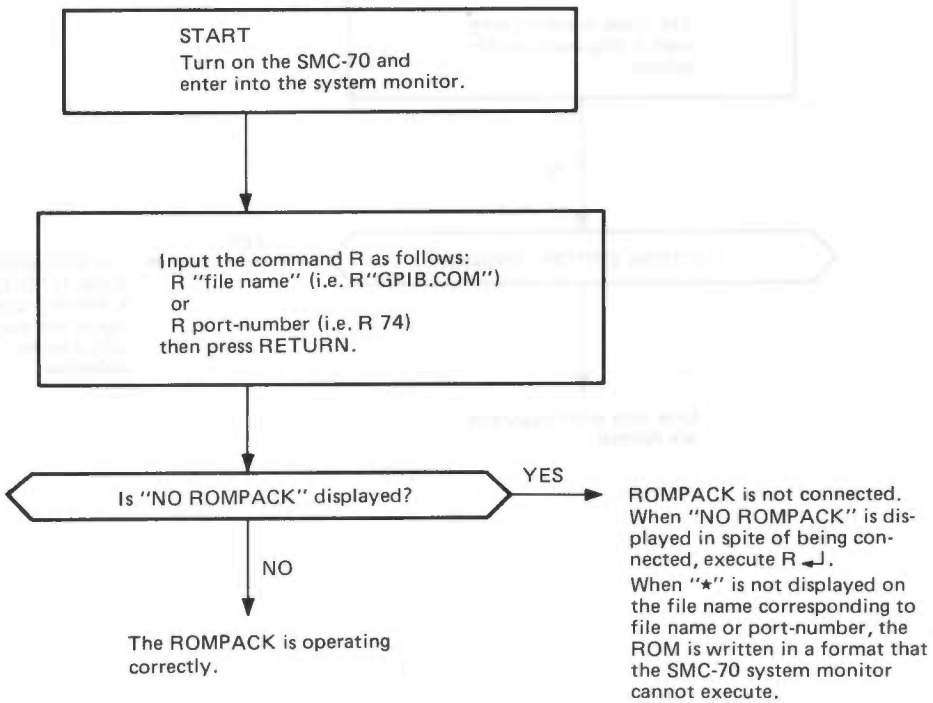
ROMPACK CHECK

The command R of the system monitor checks whether the specified ROM is connected and if its contents can be read.

Connection

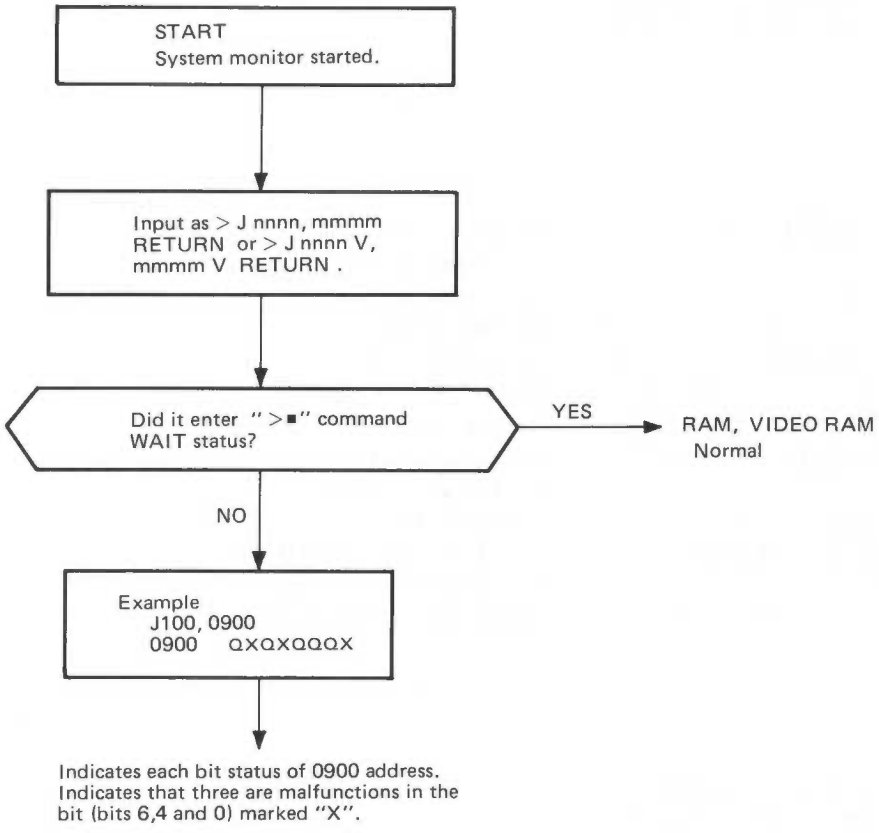


Check chart


START
Turn on the SMC-70 and enter into the system monitor.
Input the command R as follows:
R "file name" (i.e. R"GPIB.COM")
or
R port-number (i.e. R 74)
then press RETURN.
Is "NO ROMPACK" displayed?
YES
ROMPACK is not connected. When "NO ROMPACK" is displayed in spite of being connected, execute R ↵.
When "★" is not displayed on the file name corresponding to file name or port-number, the ROM is written in a format that the SMC-70 system monitor cannot execute.
NO
The ROMPACK is operating correctly.

RAM, VIDEO RAM CHECK

The system monitor is provided with a J (Justify Memory) COMMAND to check whether there are malfunction in the memory cell inside the assigned area.



Note: J COMMAND checks the existence of malfunction in regard to the checked memory by use of the combined operation of bit inversion and bit transmission. There are two routines for check; one is for checking the data area, and another for checking itself. If J0000, FFFF is RUN, the check routines changes on the way to check automatically.

7-3. DIAGNOSTICS LEVEL 2

Level 2 is placed above Diagnostics Level 0 and Level 1 and performs device checks which cannot be done by Level 0 or Level 1.

Level 2 has 11 programs to check each device and another program to perform all the checks at a time. Then one of the 11 commands, which are shown in the form of a menu when the self-check program is executed is to be chosen.

```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK ------------ (1)  check of all 11 points
    B : BEEP CHECK ------------------ (2)  speaker check
    C : CRT CHECK ------------------- (3)  monitor TV check
    D : DISK CHECK ------------------ (4)  floppydisk check
    E : CACHE DISK CHECK ------------ (5)  cache disk check
    I : IEEE-488 CHECK -------------- (6)  IEEE-488 interface check
    K : KEYBOARD/TEN KEY CHECK ------ (7)  Keyboard/Ten key unit check
    L : LIGHT PEN CHECK ------------- (8)  Light pen check
    M : MEMORY CHECK ---------------- (9)  Memory cell check
    P : PRINTER CHECK --------------- (10) Printer check
    S : TAPE CASSETTE CHECK --------- (11) Cassette tape recorder check
    T : TIMER CHECK ----------------- (12) Incorporated timer check
  ESC : END ------------------------- (13) Shelf-check program end
```

Of all the commands displayed (A~T), press the corresponding key of the desired check to start the program (the command can be input with a capital letter or a small letter). After the end of each program the screen shows the menu again and turns into the command waiting status so that the next command can be input.

Memo

RETURN Key is not needed at each input. If it is pressed, the system recognizes it as an input for designating something afterwards. "?" is displayed on the screen and the system turns into the command waiting status again.
How to terminate the self-check program. If the ESC key is pressed under the command waiting status of the self-check program, the CP/M or the system monitor goes into the command waiting status.

Memo

While each of the programs is being executed, ESC key input cannot be accepted except for checking the light pen or the keyboard. Press the ESC key after the program is over and the system turns into the command waiting status again.

(1) ALL DEVICE CHECK

A COMMAND executed 11 types of DEVICE checks, from B COMMAND to T COMMAND, IN SERIES.
When all devices you wish to check are connected, A COMMAND should be input.

```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK
    B : BEEP CHECK
    C : CRT CHECK
    D : DISK CHECK
    E : CACHE DISK CHECK
    I : IEEE-488 CHECK
    K : KEYBOARD/TEN KEY CHECK
    L : LIGHT PEN CHECK
    M : MEMORY CHECK
    P : PRINTER CHECK
    S : TAPE CASSETTE CHECK
    T : TIMER CHECK
  ESC : END

COMMAND ? A
ALL DEVICE CHECK?Y
```

COMMAND: Input A(a).

"ALL DEVICE CHECK?" is output, requesting that all DEVICE checks should be executed.
For checks, press the Y key.
When A COMMAND is input by mistake, press any key except Y, ESC, CTRL or SHIFT. Consequently, the unit returns to the command WAIT status of the self-diagnostic program.
If the Y key is pressed, the contents of B COMMAND to T COMMAND are sequentially display and executed.
For the respective assignments, operations and error message checks, refer to the individual steps.
For ALL DEVICE CHECK, "END" MESSAGE is not output even if individual DEVICE CHECKs are completed.
Moving into the next CHECK routine with no message output should be recognized to be normal. (However, visual checks are excluded.)

```
COMMAND ? A
ALL DEVICE CHECK ? Y
BEEP CHECK
CRT CHECK
```

The executed check contents are displayed in a sequential order.

When the error message is output, the device check is terminated to execute the next check.

```
CACHE DISK CHECK
NO DEVICE
IEEE-488 CHECK
KEY BOARD/TEN KEY CHECK
```

When the error message is output, the device check is terminated to execute the next check.

When all the checks are completed, "END" MESSAGE is output and the unit returns to the command WAIT status of the self-diagnostic program.

Note: To stop the check on the way, press the reset button.

(2) BEEP CHECK

```
                    SMC-70 DIAGNOSTICS

                A : ALL DEVICE CHECK
                B : BEEP CHECK
                C : CRT CHECK
                D : DISK CHECK
                E : CACHE DISK CHECK
                I : IEEE-488 CHECK
                K : KEYBOARD/TEN KEY CHECK
                L : LIGHT PEN CHECK
                M : MEMORY CHECK
                P : PRINTER CHECK
                S : TAPE CASSETTE CHECK
                T : TIMER CHECK
              ESC : END

        COMMAND ? B
        BEEP CHECK
```

Command: Input B(b).
"BEEP CHECK" message is output and the speaker outputs a one-octave tone (C – C) beep.
Malfunction check
Check and see if the speaker outputs a tone if it doesn't, the speaker improperly or it may be damaged.
Termination of the program
After the one-octave tone is output, whether there is a malfunction or not, the screen displays "FINISHED" and the system turns into the command waiting status again.

```
;++++++++++++++++++++++++++++++
;                 SOUND OUTPUT
;        DE : LENGTH
;        B : INTERVAL
;++++++++++++++++++++++++++++++
;
SOUND:
        LD      A,15H
        OUT     (1CH),A
        PUSH    DE
SOL1:   DEC     DE
        LD      A,D
        OR      E
        JR      NZ,SOL1
        POP     DE
        LD      A,05H
        OUT     (1CH),A
        PUSH    DE
SOL2:   DEC     DE
        LD      A,D
        OR      E
        JR      NZ,SOL2
        POP     DE
        DJNZ    SOUND
        RET
```

BEEP

The condition of the connection conditions between the speaker and SMC-70 cannot be judged on the SMC-70 side. Therefore, whether a speaker is connected or not, the BEEP CHECK commands the output of a beep through the speaker so that the user can judge whether normal or not by hearing the beep. This check applies to a one-octave tone. The tone is determined by the length of the program and the number of loops.

The tone is determined by the lengths of "0" and "1".

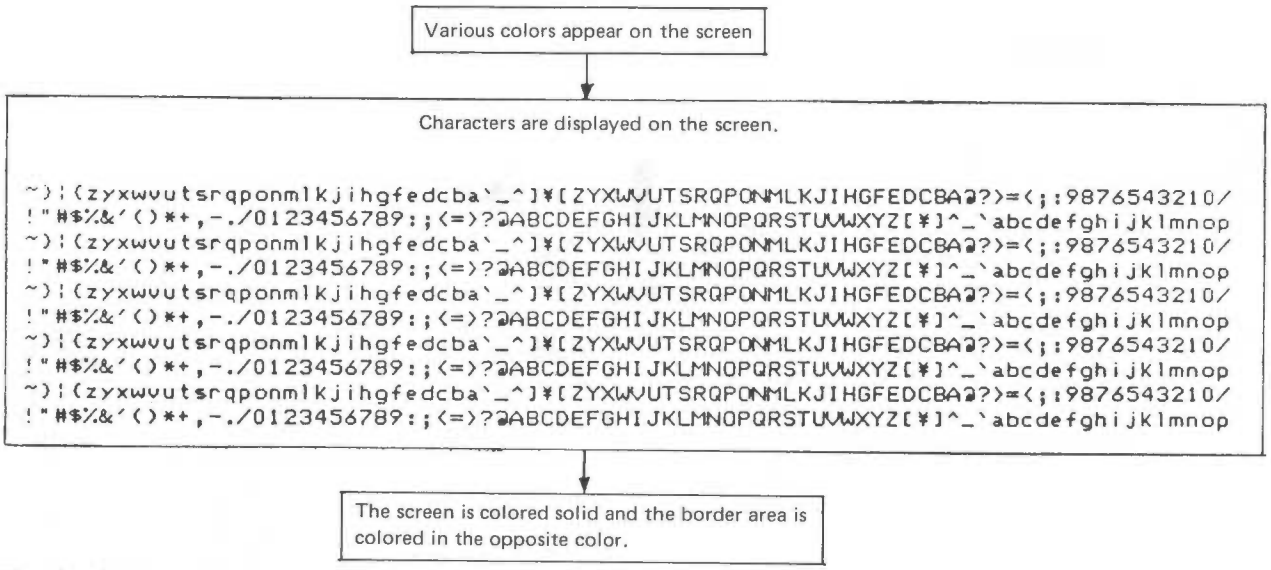
	DE	B
C	$24A_H$	40_H
D	$20A_H$	48_H
E	$1D1_H$	51_H
F	$1B7_H$	56_H
G	187_H	61_H
A	$15C_H$	$6D_H$
B	136_H	$7A_H$
C	124_H	82_H

(3) CRT CHECK

```
                    SMC-70 DIAGNOSTICS

                      A : ALL DEVICE CHECK
                      B : BEEP CHECK
                      C : CRT CHECK
                      D : DISK CHECK
                      E : CACHE DISK CHECK
                      I : IEEE-488 CHECK
                      K : KEYBOARD/TEN KEY CHECK
                      L : LIGHT PEN CHECK
                      M : MEMORY CHECK
                      P : PRINTER CHECK
                      S : TAPE CASSETTE CHECK
                      T : TIMER CHECK
                    ESC : END

COMMAND ? C
CRT CHECK
```

Command: Input C(c)

The screen shows the "CRT CHECK" message and the system starts the check.


Various colors appear on the screen
Characters are displayed on the screen.
~)¦(zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
The screen is colored solid and the border area is colored in the opposite color.

Malfunction check

Observe the monitor TV screen and check the following points:

(1) if the three kinds of display appear properly.
(2) if the lines are straight
(3) if all the colors (16 colors) are displayed
(4) if there is any color missing

If either of the planes is defective, check the other plane. For example, if red is normally output on the graphic plane, but not normally on the border plane, the cable between CRT and SMC-70 will have no malfunction.

(5) if the character display is correct

If any malfunction is noticed,

- The monitor TV connection may be improper
- The SMC-70 Video circuit may be defective
- The monitor TV may not be tuned well.

Program end

After the three displays are over, whether there is a malfunction or not, the "FINISHED" message appears on the screen and the system goes into the command waiting status.

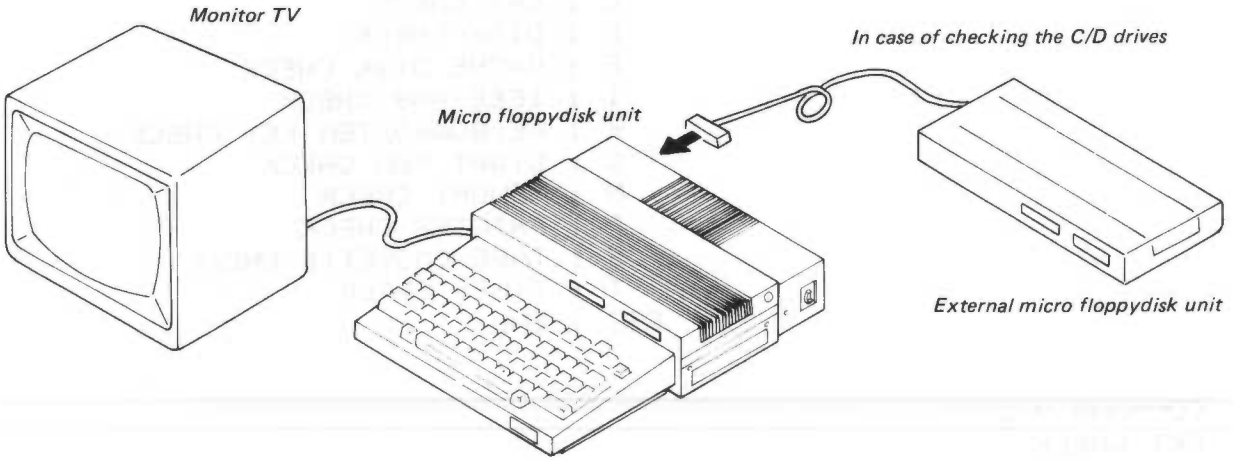
CRT

Power supply checks are completed by the level 0 and level 1 checks. This check here, therefore, checks if the data written in the VIDEO RAM (already checked by level 0) are shown correctly on the CRT, assuming that the CRT connection is correct (e.g., if the data written in the normal VIDEO RAM are output incorrectly, the CRT is to be considered defective.)

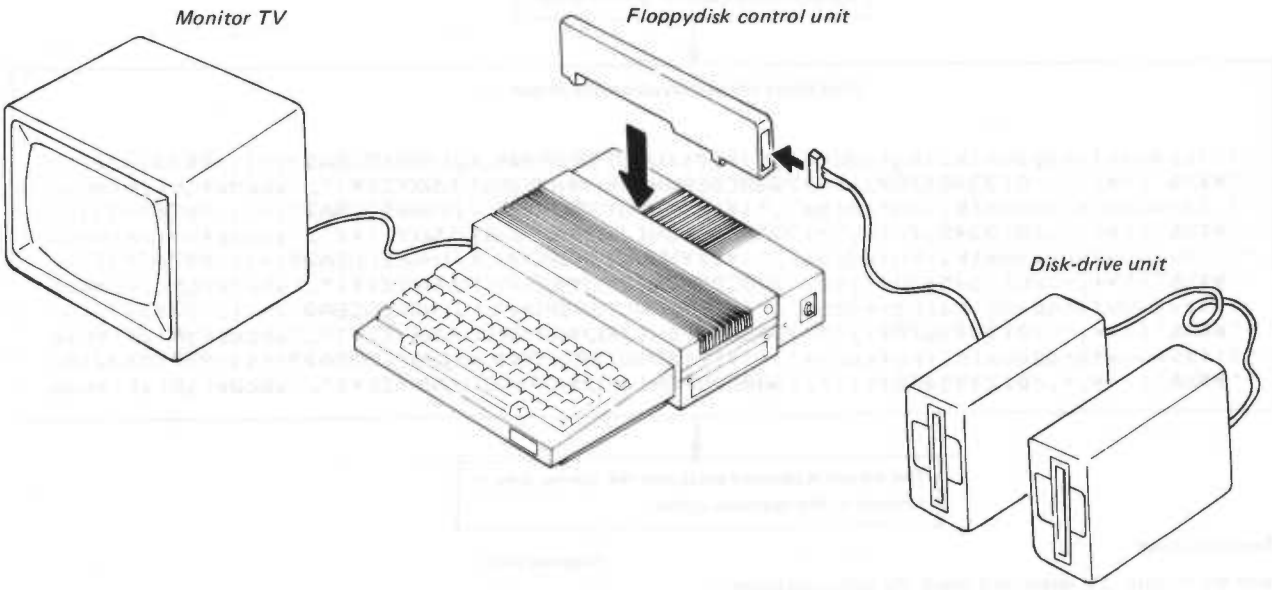
(4) DISK CHECK

Connections

In case of a micro floppydisk unit



In case of an 8-inch floppydisk unit



```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK
    B : BEEP CHECK
    C : CRT CHECK
    D : DISK CHECK
    E : CACHE DISK CHECK
    I : IEEE-488 CHECK
    K : KEYBOARD/TEN KEY CHECK
    L : LIGHT PEN CHECK
    M : MEMORY CHECK
    P : PRINTER CHECK
    S : TAPE CASSETTE CHECK
    T : TIMER CHECK
  ESC : END
```

```
COMMAND ? D
DISK CHECK
CHECK LEVEL ? (1,2)1
DISK SIZE ? (8,3)3
```

Command: Input D(d)

"DISK CHECK" is displayed and the system asks for the check level.
Check level 1: Check mode for the drive A of the floppydisk unit No.1 (the unit which is assigned to the I/O port 30_H~34_H).
Check level 2: Check mode for the checking desired disk drive by designating the disk control unit number and the drive number.
Select the desired mode (one of the two modes above) and input the mode number.
When check level 1 is selected, the system asks for the disk specification. Input 8 in case of an 8-inch disk, and 3 in case of micro floppydisk.

```
COMMAND ? D
DISK CHECK
CHECK LEVEL ? (1,2)1
DISK SIZE ? (8,3)3
```

Input the underlines characters through the keyboard.

If check level 2 is selected, designate the disk control unit number, then the drive number and then input the disk specification.

```
COMMAND ? D
DISK CHECK
CHECK LEVEL ? (1,2)2
FDC NUMBER ? (1,2)1
DRIVE ? (A-P)B
DISK SIZE ? (8,3)3
```

Designate the disk control unit number.
1. The unit assigned for the 30H–40H port
2. The unit assigned for the 28H–20H port

Designate the drive number within the range of A to P.

Memo

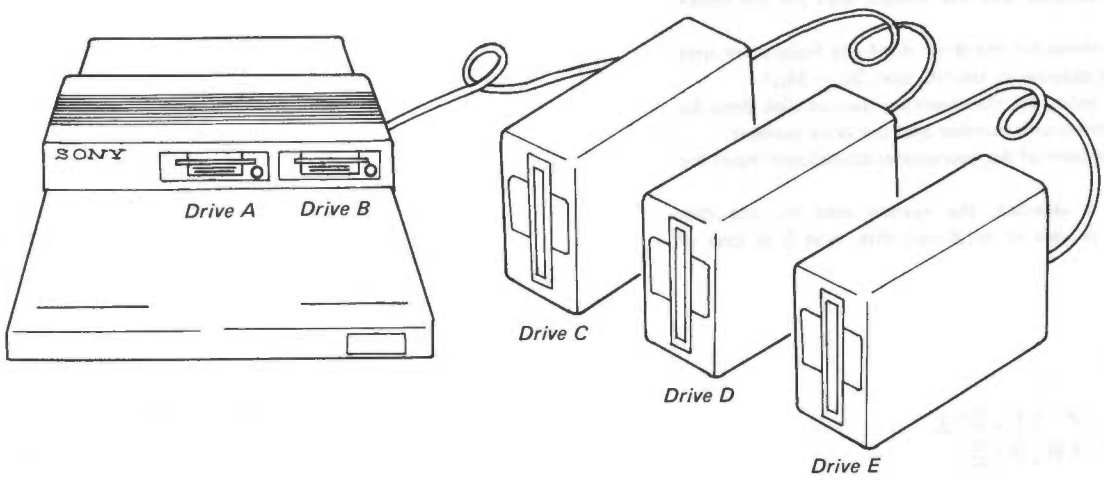
Note that if the designated number is not found in the range shown between the parentheses, "?" is displayed and the program ends there.
Both in check levels 1 and 2, after disk specification is given, the disk read check in performed and number of the track being accessed is displayed on the screen.

```
DISK SIZE ? (8,3)3
CHECKING TRACK [01]
```

Number of track being accessed. The value changes continuously.

How to designate the drive number

The drive numbers to be designated by the self-check program, unlike the drive number designated on the CP/M, are to be designated in alphabetical order starting from A on each disk control. For instance, if the disk drive is assigned on the CP/M as shown in the figure, designate the drive number as follows:



The drive number on the CP/M	The FDC number to designate	Drive number
A	1	A
B	1	B
C	2	A
D	2	B
E	2	C

Malfunction check

During the disk unit check, when a malfunction is found, an error message is displayed on the screen.

NO DEVICE: improper connection of the disk unit, defective counter, disk control unit breakdown.

DISK ERROR: reading error. An error is found on the track number displayed. Disk deferioration. Defective unit.

Program end

When any error is found, an error message is displayed and the system goes into the command waiting status again. When the check is finished and no error is found, the screen will show:

CHECKING TRACK [final track number]
FINISHED

and the system goes into the command waiting status.
The display of the final track numbers:

8-inch disk: 76
Micro-floppy disk: 69

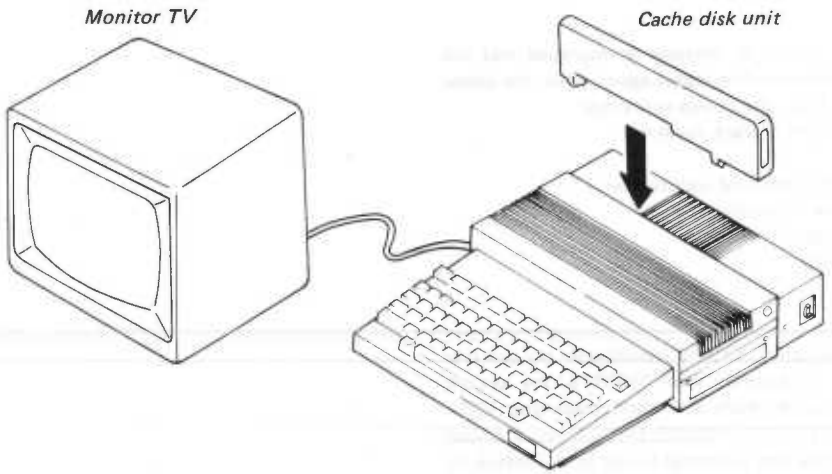
DISK

This check is a read-only program (writing would after the diskette contents). When the disk is operated with MB8876, the system sends back the error status for each operation command (CRC ERROR, SEEK ERROR, REC NOT FOUND ERROR, etc.). Check if the information in the data area is normal or not in this status. In order to check the condition of the connection between MB8876 FDC and SMC-70, write the tracknumber into the track register of MB8876, read it out and compare the two. (on the SMC-70 side, if the I/O port is read in when the corresponding device is not connected, "FFH" is obtained). SMC-70 comprises FDC1 and FDC2, each of which has 16 drives and each drive can comprise the disks of 8 and 3 inches. The user is to select all these. However, this selection is laborious when checking FDC1, A DRIVE (probably SYSTEM DRIVE); at the DIAGNOSTICS level 1, only QDx ↵ is needed. For that reason, the CHECK LEVEL is placed to enable a system drive check to be done by merely assigning the size in inches and thus omitting the laborious procedure for level 1; for level 2, the user is to make all selections to perform the check.

(5) CACHE DISK CHECK

The self-check program can also check the connection of the cache disk.

Connection




```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK
    B : BEEP CHECK
    C : CRT CHECK
    D : DISK CHECK
    E : CACHE DISK CHECK
    I : IEEE-488 CHECK
    K : KEYBOARD/TEN KEY CHECK
    L : LIGHT PEN CHECK
    M : MEMORY CHECK
    P : PRINTER CHECK
    S : TAPE CASSETTE CHECK
    T : TIMER CHECK
  ESC : END
```

```
COMMAND ? E
CACHE DISK CHECK
DRIVE ? (A-P)A
```

Command: Input E(e)

"CACHE DISK CHECK" is displayed and the system asks for the drive number. Designate the drive number within the range of A-P.

Malfunction check

When a connection error of the cache disk unit is found, "NO DEVICE" is displayed.
In this case:

- The connection may be improperly done.
- The SMC-70 I/C bus may be defective.
- The cache disk unit itself may be defective.

Program end

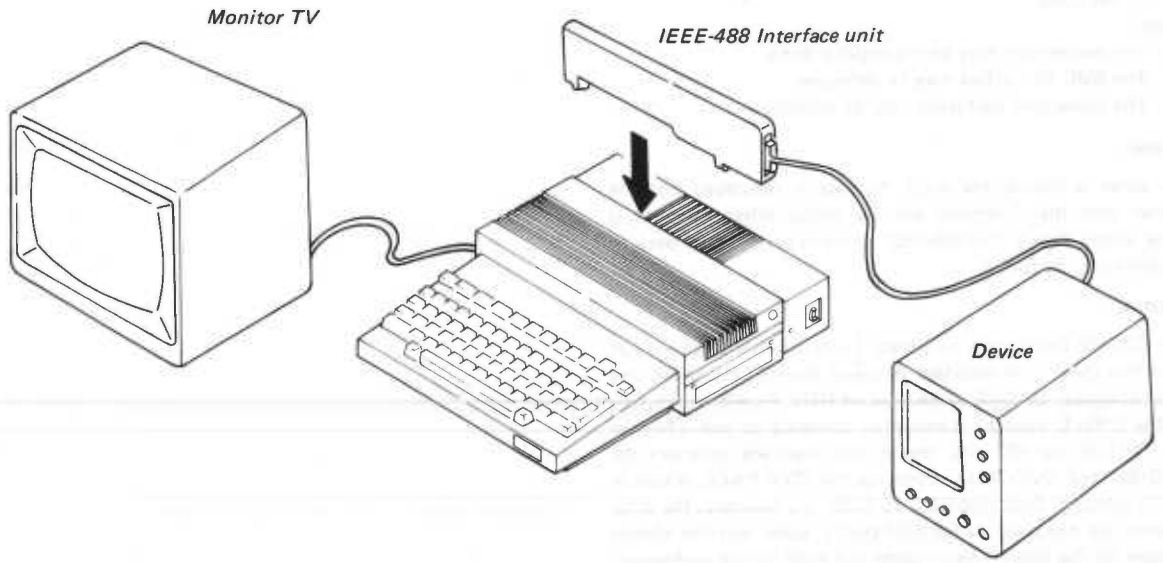
When an error is found, the error message is displayed and the system goes into the command waiting status. When no error is found, the screen shows. "FINISHED" and the system goes back to the command waiting status.

CACHE DISK

Up to 16 CACHE DISKs can be added. Each disk has a capacity of 256kB. In this check, the interface between the CACHE DISK and SMC-70 is checked. CACHE DISK has an RDY FLAG which tells whether the DRIVE selected is mounted correctly or not. The user selects a DRIVE (0–15) and checks the interface between the CACHE DISK and SMC-70 by checking the TDY FALG status of the DRIVE selected. Since the CACHE DISK is a memory, the error status cannot be obtained in READ/WRITE time. Further checks are excessive for the size of the program and shall not be performed.

(6) IEEE-488 CHECK

Connection




```
SMC-70 DIAGNOSTICS

     A : ALL DEVICE CHECK
     B : BEEP CHECK
     C : CRT CHECK
     D : DISK CHECK
     E : CACHE DISK CHECK
     I : IEEE-488 CHECK
     K : KEYBOARD/TEN KEY CHECK
     L : LIGHT PEN CHECK
     M : MEMORY CHECK
     P : PRINTER CHECK
     S : TAPE CASSETTE CHECK
     T : TIMER CHECK
   ESC : END

COMMAND ? I
IEEE-488 CHECK
```

Command: Input I(i)

"IEEE-488 CHECK" is output and the system checks the condition of the connections to the GPIB interface board.

Malfunction check

If an improper connection is found between the GPIB and the unit, the screen shows "NO DEVICE",
In this case:

- The connections may be in error.
- The SMC-70 I/O bus may be defective.
- The interface unit may be defective.

Program end

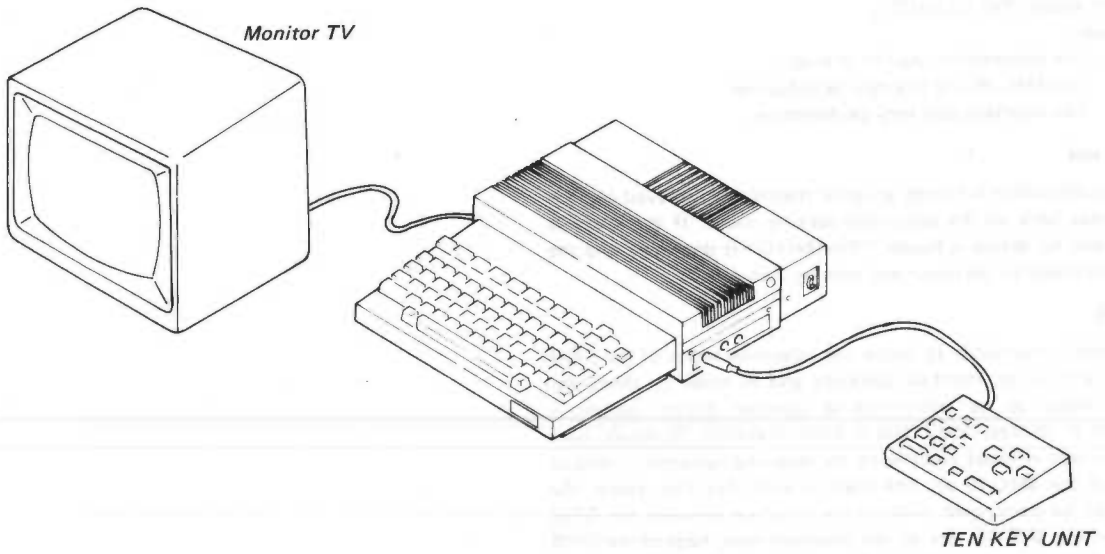
When a malfunction is found, an error message is displayed and the system goes back to the command waiting status. If the check is finished and no defect is found, "FINISHED" is displayed and the system goes back to the command waiting status.

IEEE-488

It is probably impossible to check the operation status of the GPIB UNIT; GPIB is an interface standard and in order to check this, SMC-70 needs to be connected to another device (which is unknown) to communicate data in both directions. However, data cannot be sent without identifying the receiving equipment; data to be sent to the SMC-70 are unknown as well. For this reason, the check shall be performed only on the interface between the GPIB UNIT and the SMC-70. Set all the interrupt mask flags of the GPIB to "0", if the interface for reading should be "0". (The status should become "1" if the same operation is performed with the GPIB UNIT disconnected.) Decide whether the interface is normal or not judging from the status.

(7) KEYBOARD/TEN KEY CHECK

Connection




```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK
    B : BEEP CHECK
    C : CRT CHECK
    D : DISK CHECK
    E : CACHE DISK CHECK
    I : IEEE-488 CHECK
    K : KEYBOARD/TEN KEY CHECK
    L : LIGHT PEN CHECK
    M : MEMORY CHECK
    P : PRINTER CHECK
    S : TAPE CASSETTE CHECK
    T : TIMER CHECK
  ESC : END

COMMAND ? K
KEYBOARD/TEN KEY CHECK
```

COMMAND: Input K(k).

"KEYBOARD/TEN KEY CHECK" is output. Press any keys except the ESC key one after another on the KEYBOARD or TEN KEY UNIT to check that the input is directly output on the CRT.

Malfunction check

Check that characters corresponding to the pressed key are correctly display on the monitor TV screen. When keys (TAB, BS, RETURN, ↑, etc.) other than character input keys are pressed, characters having the actual key code + 40H code are displayed together with a " ∧ " mark. For example, "∧ I" is displayed when the TAB key in pressed.
If no character corresponding to the pressed key are displayed, or if no display appears, check the following.

- Defective keyboard connection
- Defective keyboard encode
- Defective ten key unit

Program end

Press the ESC key to return the menu mode of the self-diagnostic program after checks are completed. The unit returns again to the command WAIT status with "FINISHED" displayed.

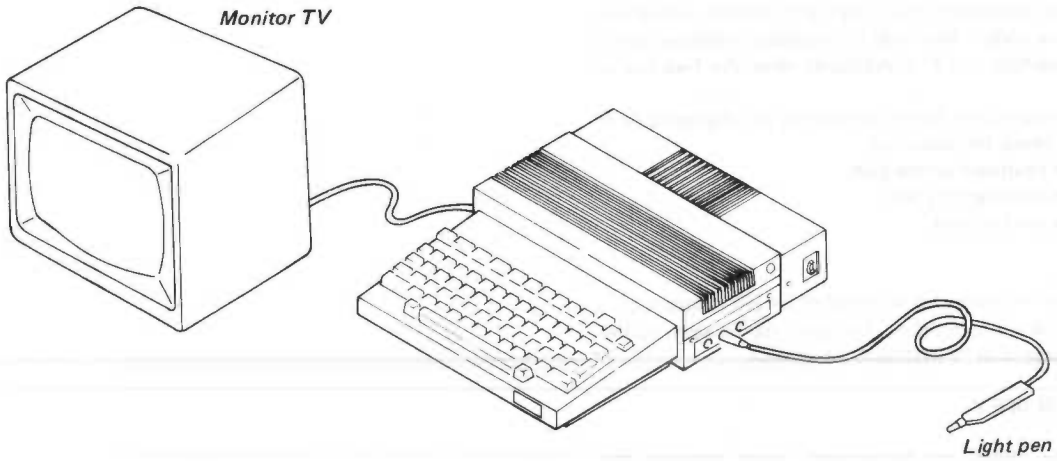
KEYBOARD/TEN KEY

It is impossible to check the connection status between the keyboard encoder M5L8C41A and SMC-70. However, without the input from the keyboard, it is impossible to give a SIMON command or operate the DIAGNOSTICS level 2. Therefore, in order to perform this check, assume that the keyboard is connected to SMC-70 properly, and output on CRT the code from the keyboard and then compare the key codes/(which are input)/with the characters displayed on the CRT.
As for a datum without FONT (such as a control code), add 40H and put the control mark " ∧ " for identification and then output it.

Ex. If TAB (09H) is input from the keyboard, ∧ I (49H) is displayed on the CRT.

(8) LIGHT PEN CHECK

Connection




```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK
    B : BEEP CHECK
    C : CRT CHECK
    D : DISK CHECK
    E : CACHE DISK CHECK
    I : IEEE-488 CHECK
    K : KEYBOARD/TEN KEY CHECK
    L : LIGHT PEN CHECK
    M : MEMORY CHECK
    P : PRINTER CHECK
    S : TAPE CASSETTE CHECK
    T : TIMER CHECK
  ESC : END

COMMAND ? L
```

COMMAND: Input L(l).

Character pad "ⓐ" is output in four colors on the CRT screen. Press the position of any ⓐ mark lightly using a light pen to check that the ⓐ mark changes into white "#" mark.

Malfunction check

Check that the ⓐ mark in the position pressed by a light pen changes into a "#" mark. If no change occurs, check for the following.

- Defective light pen
- Defective connection of light pen cord or connector
- Internal malfunction of SMC-70

Program end

When the ESC key is pressed for check end, the "FINISHED" message appears on the screen. The unit returns to the command WAIT status of the self-diagnostic program.

LIGHT PEN

Since the input data from the light pen contain a fairly large amount of error, this cannot be checked as it is. Therefore, the data must be modified somewhat by means of software.
The possible errors are; (1) error due to the light pen characteristics (2) error due to the relation between the CRT and the light pen.
The error no./(1) originates from the limited range of the characters to be designated with the pen in 80-character mode: 5 characters comprising the center character and on character on top, bottom, right and left around the center. (e.g. through only one character is desired and designated, the address to be input cannot be known).
The error no./(2) means that due to the scanning line on the CRT, the address input slides to the right by about 6 characters from the position designated in the 80-character mode. Considering the above two errors, the system outputs the characters pads on the CRT so that the user can designate the pad desired and see if it is normal or not judging from the change of the pad.

(9) MEMORY CHECK

```
SMC-70 DIAGNOSTICS

  A : ALL DEVICE CHECK
  B : BEEP CHECK
  C : CRT CHECK
  D : DISK CHECK
  E : CACHE DISK CHECK
  I : IEEE-488 CHECK
  K : KEYBOARD/TEN KEY CHECK
  L : LIGHT PEN CHECK
  M : MEMORY CHECK
  P : PRINTER CHECK
  S : TAPE CASSETTE CHECK
  T : TIMER CHECK
ESC : END

COMMAND ? M
MEMORY CHECK
```

COMMAND: Input M(m).

"MEMORY CHECK" is output, and the WRITE/READ operation of the main memory and video RAM is checked. The memory contents before starting checks are all retained. When the M key is pressed, a single datum is written into the memory element and then read. The whole area of the main memory (64K Bytes), C RAM (2K Bytes), A RAM (2K Bytes), PCG (2K Bytes), and G RAM (32K Bytes) is checked.

Malfunction check

If it is found that they are different by comparing the written data with the read data, the following is displayed.

MEMORY ERROR (MAIN MEMORY error)

or

VIDEO MEMORY ERROR (VIDEO RAM error)

If error display appears, check the following.

- Defective memory element
- Defective internal bus

Program end

When errors are detected, the program stops at that point. The unit enters the command WAIT status with error message displayed. When checks are completed, the unit return to the command WAIT status with "FINISHED" displayed.

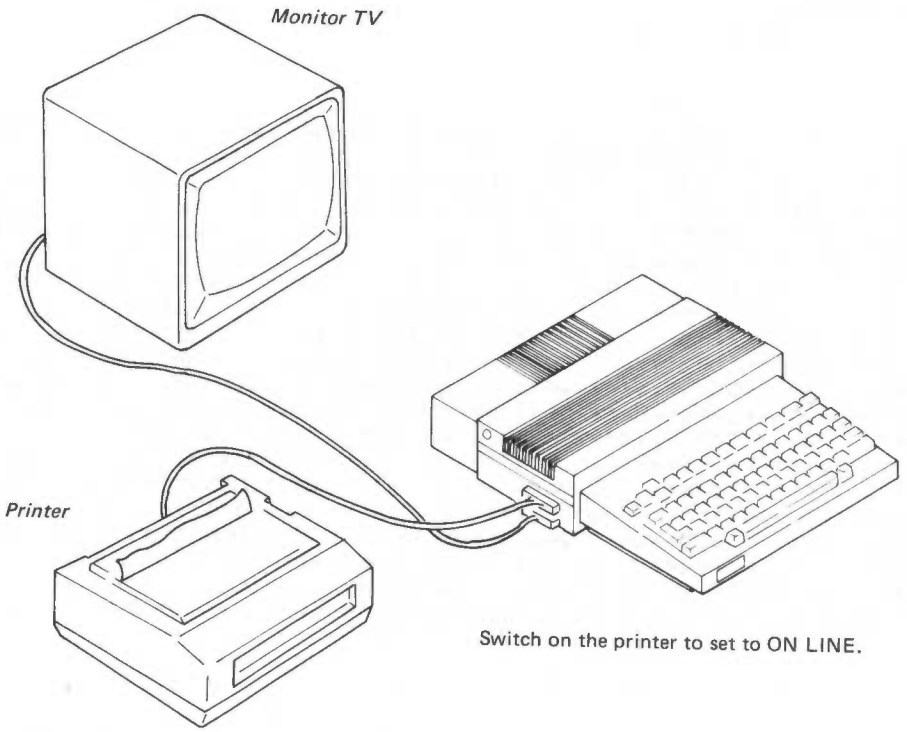
MEMORY

The MEMORY CHECK should be R/W, and the MEMORY contents should not be destroyed when the CHECK is completed.
All of the contents of the SMC-70 RAM (MAIN MEMORY, V RAM)/are checked.
For the CHECK method, read the RAM contents twice and compare them. Then, compute the data complements, write them in then, read them out and compare, and then return the contents to what they were originally. This check is executed for the MAIN MEMORY and V RAM.

```
LD      A,(HL)
LD      B,(HL)
CP      B
JP      NZ,ERROR ──→ READ ERROR
CPL
LD      (HL),A
LD      A,(HL)
AND     B
JP      NZ,ERROR ──→ WRITE ERROR
LD      (HL),B
RET
```

(10) PRINTER CHECK

Connection



Switch on the printer to set to ON LINE.

```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK
    B : BEEP CHECK
    C : CRT CHECK
    D : DISK CHECK
    E : CACHE DISK CHECK
    I : IEEE-488 CHECK
    K : KEYBOARD/TEN KEY CHECK
    L : LIGHT PEN CHECK
    M : MEMORY CHECK
    P : PRINTER CHECK
    S : TAPE CASSETTE CHECK
    T : TIMER CHECK
  ESC : END

COMMAND ? P
PRINTER CHECK
```

COMMAND: Input P(p).

"PRINTER CHECK" is output on CRT. Characters are output to the PRINTER.
The first five lines start with character code 21_H, and up to 70_H characters are normally printed. On the next five line, characters $7E_H$ to $2F_H$ are printed in reverse order.
On the following ten lines, characters of 21_H to 70_H and $7E_H$ to $2F_H$ are double-printed respectively.
On the last five lines, "!" marks are printed at every horizontal tabulation position.

```
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
!"#  '&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[¥]^_`abcdefghijklmnop
~}|{zyxwvutsrqponmlkjihgfedcba`_^]¥[ZYXWVUTSRQPONMLKJIHGFEDCBA@?>=<;:9876543210/
          !         !!         !!!         !!!!         !!!!!         !!!!!!         !!!!!!!         !!!!!!!!
          !         !!         !!!         !!!!         !!!!!         !!!!!!         !!!!!!!         !!!!!!!!
          !         !!         !!!         !!!!         !!!!!         !!!!!!         !!!!!!!         !!!!!!!!
          !         !!         !!!         !!!!         !!!!!         !!!!!!         !!!!!!!         !!!!!!!!
          !         !!         !!!         !!!!         !!!!!         !!!!!!         !!!!!!!         !!!!!!!!
```

Malfunction check

When the printer is defectively connected or not set to ON LINE, "NO DEVICE" is displayed on the screen. For other errors, check the following from the printed result.

(1) Are the characters correctly printed?
(2) In double printing, do characters slip down?
(3) Are characters printed in the correct order?
(4) Are any printed characters omitted?
(5) Is tabulation executed every eight characters?

For errors, check the following.

- Defective printer connection (Defective contact of cables or connectors)
- Defective internal, printer
- Defective I/O bus of SMC-70

Program end

For NO DEVICE, when errors are detected, the message is immediately displayed and the unit returns to the command WAIT status. For other errors, when the data output ends irrespective of the existence of errors, "FINISHED" appears.
Consequently, the unit returns to the command WAIT status of the self-diagnostic program.

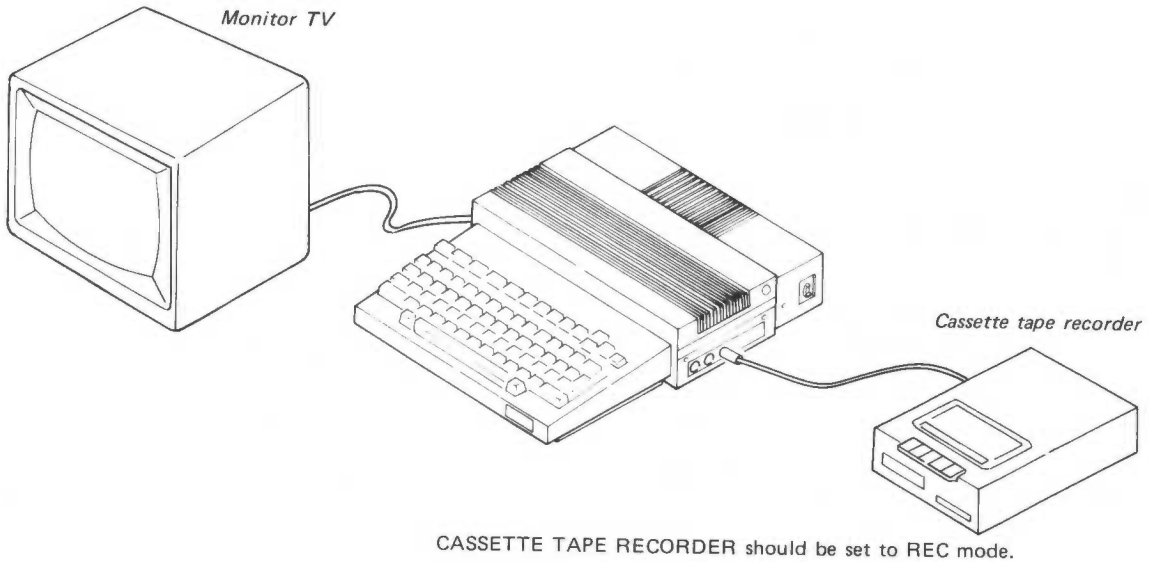
PRINTER

The status of the PRINTER can be judged from the display of PRINTER BUSY STATUS. This STATUS indicates that the PRINTER is ready for DATA receiving. If the STATUS remains BUSY too long (for approx. four seconds), the PRINTER is not connected or not set to ON LINE, and an error message is given.
The operation status of the PRINTER cannot be recognized from the SMC-70 side. Therefore, the operation status is recognized by the user from the result printed out when the PRINTER is caused to operate in a fixed test pattern. First, print 80 CHARACTERs in the normal order (21_H-) (five times), and then execute the same in the reverse order ($7E_H$-); then all of the CHARACTERs will be output to the PRINTER.
Then, OVER WRITE/(double print) is executed in both normal and reverse orders to check the operation of the PRINTER MECHANIC section.
Lastly, check the control code (TAB) operation.

(11) TAPE CASSETTE CHECK

This program checks the connection status of the TAPE RECORDER as well as the COMMAND of diagnostics level 1.

Connection



CASSETTE TAPE RECORDER should be set to REC mode.

```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK
    B : BEEP CHECK
    C : CRT CHECK
    D : DISK CHECK
    E : CACHE DISK CHECK
    I : IEEE-488 CHECK
    K : KEYBOARD/TEN KEY CHECK
    L : LIGHT PEN CHECK
    M : MEMORY CHECK
    P : PRINTER CHECK
    S : TAPE CASSETTE CHECK
    T : TIMER CHECK
  ESC : END

COMMAND ? S
TAPE CASSETTE CHECK
```

COMMAND: Input S(s).

"TAPE CASSETTE CHECK" is output to check the tape cassette interface.

Malfunction check

When the tape recorder is defectively connected, "NO DEVICE" is displayed. In this case, check the following.

- The tape recorder is not in REC mode.
- Defective connection of cables or connections.
- The tape recorder is not correctly connected.

Program end

When an error is detected, an error message is displayed and the unit returns to the command WAIT status.
When checks are completed, "FINISHED" appears and the unit enters the next command WAIT status.

TAPE CASSETTE

The connection status of the TAPE CASSETTE cannot be checked independently by the SMC-70.
Therefore, the connection status is recognized by the returned DATA variation by connecting SMC-70 and TAPE CASSETTE (as shown in the figure below) and sending DATA from the SMC-70 side.
Normally, when the SMC-70 is in the REC mode, the DATA input from MIC is directly output from EXT. (No change occurs whether PAUSE is pressed or not.)
However, the input and output from the SMC-70 side are digital and the input and output from the TAPE CASSETTE are analog, so the SMC-70 side is provided with a differentiating circuit and integrating circuit. When what is output as "1" on the SMC-70 side is input again to the SMC-70 side through the TAPE CASSETTE, it is not necessarily "1".
However, if the SMC-70 and the TAPE CASSETTE are connected in normally, the inputs will naturally be different depending on whether "1" is output or "0" is output from the SMC-70 side, whereby the CHECK should be executed.
The DATA variations in ("L" ⌈"H"⌉) and ("H" ⌊"L"⌋) are checked.

(12) TIMER CHECK

```
                                    SMC-70 DIAGNOSTICS

                                      A : ALL DEVICE CHECK
                                      B : BEEP CHECK
                                      C : CRT CHECK
                                      D : DISK CHECK
                                      E : CACHE DISK CHECK
                                      I : IEEE-488 CHECK
                                      K : KEYBOARD/TEN KEY CHECK
                                      L : LIGHT PEN CHECK
                                      M : MEMORY CHECK
                                      P : PRINTER CHECK
                                      S : TAPE CASSETTE CHECK
                                      T : TIMER CHECK
                                    ESC : END

COMMAND ? T
TIMER CHECK
TIMER SET ?(Y/N)N
```

COMMAND: Input T(t).

"TIMER CHECK" MESSAGE is output.
It is requested whether time should be set to the TIMER. When "N" is input, the contents of the TIMER are displayed for ten seconds on the CRT, and then CHECK is completed.
When "Y" is input, "SET DATE?" MESSAGE is output. Next, input DATA in the sequence of month, day, year, time, minute, second and day of the week, and then press RETURN.
Then, the contents of the TIMER are displayed for ten seconds. Compare the set contents with the displayed those to check the existence of malfunction.
SET DATE?

05	18	82	10	45	23	TU
month	day	year	time	minute	second	day of the week

The days of the week are as follows:

Sunday – SU	Wednesday – WE	Saturday – SA
Monday – MO	Thursday – TH	
Tuesday – TU	Friday – FR	

Malfunction check

When the timer cannot be accessed due to the defective connection of the timer element or when the count cannot be executed due to the defective timer element, "NO DEVICE" is displayed.
For other message, check the following according to the time data displayed on the screen.

(1) Is the time correctly displayed?
(2) Is the timer incremented every second?
(3) Is carrying correctly executed when incrementing?

When there are errors in time display, check the following.

- No time is set the timer.
- Defective contact of timer circuit
- Defective timer element

Program end

For NO DEVICE, the unit returns immediately to the command WAIT status. For other messages, the unit returns to the command WAIT status of self-diagnostic program ten seconds later irrespective of the read data.

TIMER

The BUSY signal sent from the TIMER is used to recognize the connection status between the TIMER and SMC-70. This signal will become high for 427μs once a second to count the time inside 58321RS. When the signal is observed to be high for 427μs or more (the contents of the non-connected DEVICE I/O port are high on the SMC-70 side), the TIMER 58321RS will not be connected.
The TIMER operation is to be checked by the user by outputting the contents of the TIMER COUNTER on the CRT for approx. 10 seconds (as shown in the figure below) according to the output variation.

05/18/82 TU 10:45:23

(13) END

```
SMC-70 DIAGNOSTICS

    A : ALL DEVICE CHECK
    B : BEEP CHECK
    C : CRT CHECK
    D : DISK CHECK
    E : CACHE DISK CHECK
    I : IEEE-488 CHECK
    K : KEYBOARD/TEN KEY CHECK
    L : LIGHT PEN CHECK
    M : MEMORY CHECK
    P : PRINTER CHECK
    S : TAPE CASSETTE CHECK
    T : TIMER CHECK
  ESC : END

COMMAND ?
```

COMMAND: Input "ESC".

This command indicates that the PROGRAM end is reached. By inputting the command, this PROGRAM comes to an end and returns to CP/M or SYSTEM MONITOR.

SECTION 8
SIGNATURE ANALYZER'S VALUE

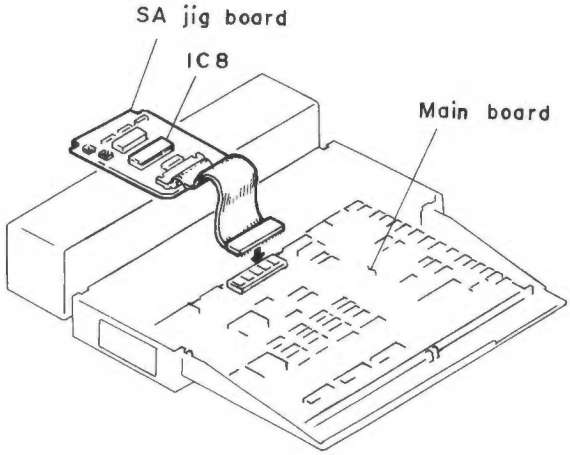
8-1. USING THE SIGNATURE ANALYZER

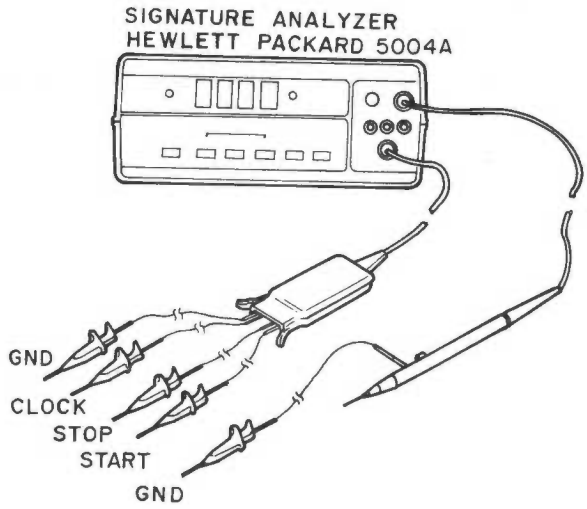
(1) Remove the keyboard and sub board so that only the main board is mounted.

(2) Remove IC8 from the main board and mount the IC8 onto the SA jig board (J-6205-290-A).

(3) Insert the connector from the SA jig board (J-6205-290-A) into the position onto which IC8 on the main board has been mounted, and then connect the main board to the jig.

(4) Using the signature analyzer (HEWLETT PACKARD 5004A) specified, take measurement by setting the switches on the signature analyzer and SA jig board (J-6205-290-A), as described below.





8-2. TEST 0 1

Tested Point:

Z-80 & ADDRES BUFFER TEST

Analyzer Setting:

CLOCK : ⌐ : Z-80 PIN 21 ($\overline{RD}$) OR IC5 PIN 4
START : ⌐ : Z-80 PIN 5 ADR-15 OR IC9 PIN 14
STOP : ⌐ : Z-80 PIN 5 ADR-15 OR IC9 PIN 14

Jig Sw Setting:

SW1	SW2	SW3	SW4
CLOSE	CLOSE	CLOSE	CLOSE

Check Point:

CHECK : IC5, IC8 (Z-80) PIN ALL, IC9, IC10, IC11, IC12, IC15, IC111, IC112, IC113, IC114, IC115

IC PIN	5	8	IC PIN	8	IC PIN	9	10	11	12	15	111	112	113	114	115
1	0000	1293	21	0000	1	0000	0000	0000	0000	755P	0000	0000	0000	0000	0000
2		HAP7	22	0001	2	HPP0	5H21	UUUU		3827		HPP0	5H21		UUUU
3	0001	3C96	23		3	HPP0	5H21	UUUU		0000	0000	HPP0	5H21		UUUU
4	0000	3827	24	0001	4	1293	0AFA	5555		64HP	0000	1293	0AFA		5555
5	0000	755P	25	0000	5	1293	0AFA	5555		1181	0000	1293	0AFA		5555
6	0001	0001	26	0000	6	HAP7	UPFH	CCCC		0001	0001	HAP7	UPFH		CCCC
7	0001		27		7	HAP7	UPFH	CCCC		0001	0001	HAP7	UPFH		CCCC
8	0000		28	0001	8	0000	0000	0000			0000	0000	0000		0000
9	0001		29	0000	9	3C96	52F8	7F7F			0001	3C96	52F8		7F7F
10	0001		30	UUUU	10	3C96	52F8	7F7F	0000		0001	3C96	52F8	0000	7F7F
11	0000	0001	31	5555	11	3827	HC89	0001				3827	HC89		
12	0000		32	CCCC	12	3827	HC89	0001			0000	3827	HC89		0001
13	0001		33	7F7F	13	755P	2H70	0000				755P	2F70		
14	0001		34	5H21	14	755P	2H70	0000				755P	2F70		0001
15	0000		35	0AFA	15	0000	0000	0000			0001	0000	0000		0001
16	0001	0001	36	UPFH	16	0001	0001	0001			0001	0001	0001		0001
17		0001	37	52F8	17										
18		0001	38	HC89	18										
19			39	2H70	19				2UA3					2UA2	
20		0001	40	HPP0	20				0001					0001	

8-3. TEST 0 2

Tested Point:
ROM-A TEST

Analyzer Setting:
CLOCK : ⌐ : Z-80 PIN 21 ($\overline{RD}$) OR IC5 PIN 4
START : ¬ : IC15 PIN 4
STOP : ¬ : IC15 PIN 5

Jig Sw Setting:

SW1	SW2	SW3	SW4
CLOSE	CLOSE	CLOSE	CLOSE

Check Point:
CHECK : IC27 (ROM-A)

IC PIN	27	IC PIN	27
1	1180	16	7961
2	H6AA	17	7309
3	4PCC	18	7H82
4	A7A2	19	5U90
5	108P	20	0000
6	5342	21	0P0P
7	1100	22	0000
8	0108	23	0F62
9	052A	24	5HC4
10	0U7U	25	FF4F
11	PP1P	26	P254
12	81FU	27	1180
13	AH89	28	1180
14	0000		
15	7263		

8-4. TEST 0 3

Tested Point:
ROM-B TEST

Analyzer Setting:
CLOCK : ⌐ : Z-80 PIN 21 ($\overline{RD}$) OR IC5 PIN 4
START : ¬ : IC15 PIN 5
STOP : ⌐ : IC15 PIN 1

Jig Sw Setting:

SW1	SW2	SW3	SW4
CLOSE	CLOSE	CLOSE	CLOSE

Check Point:
CHECK : IC28 (ROM-B)

IC PIN	28	IC PIN	28
1	1180	16	6P09
2	H6AA	17	1U70
3	4PCC	18	2P1C
4	A7A2	19	0U88
5	108P	20	0000
6	5342	21	0P0P
7	1100	22	0000
8	0108	23	0F62
9	052A	24	5HC4
10	0U7U	25	FF4F
11	96A3	26	P254
12	CU63	27	1180
13	UH52	28	1180
14	0000		
15	31FF		

8-5. TEST 11

Tested Point:
INTERNAL I/O WRITE TEST

Analyzer Setting:
CLOCK : ↘ : Z-80 PIN 22 OR IC5 PIN 6
START : ↗ : Z-80 PIN 1 ADR-11 OR IC9 PIN 4
STOP : ↗ : Z-80 PIN 40 ADR-10 OR IC9 PIN 2

Jig Sw Setting:

SW1	SW2	SW3	SW4
OPEN	CLOSE	CLOSE	CLOSE

Check Point:
CHECK : IC1, IC2, IC15, IC30, IC34, IC35, IC41, IC43, IC71, IC72, IC73, IC74, IC75, IC76, IC77, IC108, IC114, IC116, IC117, IC118, IC119, IC120, IC121, IC122, IC123

IC PIN	1	2	15	30	34	35	41	43	71	72	73	74	75
1	0000				0C6P	0000	0000	FFFU	0C6P	0000	0000	0C6P	0PH9
2	0C6P				0C6P	0C6P	CA0U		0000	0PH9	0000	0C6P	85AU
3	0C6P				0000	F667	0C16		0C6P		0000	0C6P	8018
4	0C6P				0000	FH09	U003		0000	0C6P		0000	0000
5	0000				0000	0000	CA30	3H7P	0000	0000	0000	8018	0C6P
6	0C6P				0C6P	0C6P	29C4		0C6P	0C6P	0C6P	8018	
7	0000				0000	0000	H30A	0000	0000	0000	0000	0000	0000
8	0000				0000	0000	44CU	0C6P	85AU	0C6P	0C6P	8018	
9	0C6P		0C6P		0C6P	0C6P	0FF7		8PF1		0000	0000	05C7
10	0000		0C6P	0000	0C6P	0000	0000	0000		0000	0000	8018	
11	0C6P	15F9	0C6P	0C6P	0C6P	0C6P	0C6P	3H7P		0000	0000	0C6P	0C6P
12	0C6P	8005	0C6P		FH09	0000	HFH3	FP14		0C6P	0C6P	0000	
13	0C6P	F7A1	U33U		0000		PHU0	F7A1		0000	0000	0C6P	0000
14	0C6P		087C		0C6P	0C6P	CP28	0C6P	0C6P	0C6P	0C6P	0C6P	0C6P
15			0C6P				80C9						
16							9422						
17							671U						
18							21CF						
19							C70A						
20							0C6P						

IC PIN	76	77	108	114	116	117	118	119	120	121	122	123
1	0C6P	0C6P		0000	0C6P	0000	8018	0C6P		85AU	8018	0C16
2	0C6P	0C6P	0000		8C76		8C76	0C6P		85AU	85AU	U003
3	0000	0C6P	0C6P		0C6P		0000	0C6P	0C6P	8PF1	85AU	H30A
4	0000	0C6P	0000		8018	H3CP	0C6P	0C6P	0C6P	6842	05C7	P42F
5	0000	0C6P	0000		8C76	8C76	8PF1	0C6P	0C6P	8018	0C6P	9105
6	0C6P	0000	0C6P		0C6P	6842	85AU	0C6P	0C6P	58F8	0C6P	UU39
7	0000	0000	0000		0000	0000	0000	0000	0000	0000	8PF1	6UCC
8	0C6P	0C6P	0000		8C76	0000	8018	0C6P	0C6P	0C6P	0000	0000
9		0000	0C6P		0C6P	0000	8C76	0C6P	97CP	H3CP	AF5A	9P3P
10	0000	0C6P	FFFU		8018	0C6P	8C76	0C6P	0C6P	0000	97CP	AC3H
11	0C6P	0000	F7A1		8PF1	85AU	8018	0C6P	0C6P	8PF1	782F	3UHH
12	0000	0000	9A6C		8018	85AU	0000	0C6P	0C6P	8C76	F667	5388
13	0000	0C6P	9105		0C6P	8PF1	0C6P	0C6P	0C6P	85AU	6842	PHU0
14	0C6P	0C6P	0C6P		0C6P	0C6P	0C6P	0C6P	0C6P	0C6P	U33U	0C6P
15											8PF1	0C6P
16											0C6P	0C6P
17												
18												
19				0C6P								
20												

8-6. TEST 12

Tested Point:

EXTERNAL I/O WRITE TEST

Analyzer Setting:

CLOCK : ↘ : Z-80 PIN 22 OR IC5 PIN 6
START : ↗ : Z-80 PIN 2 ADR-12 OR IC9 PIN 6
STOP : ↗ : Z-80 PIN 40 ADR-10 OR IC9 PIN 2

Jig Sw Setting:

SW1	SW2	SW3	SW4
OPEN	CLOSE	CLOSE	CLOSE

Check Point:

CHECK : IC1, IC2, IC15, IC30, IC34, IC35, IC41, IC43, IC71, IC72, IC73, IC74, IC75, IC76, IC77, IC108, IC114 IC116, IC117, IC118, IC119, IC120, IC121, IC122, IC123

IC PIN	1	2	15	30	34	35	41	43	71	72	73	74	75
1	0000				5A28	0000	0000	5A28	5A28	0000	0000	5A28	U73F
2	5A28				5A28	5A28	5A28		0000	U73F	0000	5A28	0000
3	5A28				0000	5A28	AH14		5A28		0000	5A28	AH14
4	5A28				0000	0000	0000		0000	5A28		0000	0000
5	0000				0000	0000	5A28	5A28	0000	0000	0000	AH14	5A28
6	5A28				5A28	5A28	5A28		5A28	5A28	5A28	AH14	
7	0000				0000	0000		0000	0000	0000	0000	0000	0000
8	0000				0000	0000		5A28	0000	5A28	5A28	AH14	
9	5A28		5A28		5A28	5A28	5A28		5A28		0000	1PC3	AH14
10	0000		5A28	0000	5A28	AH14	0000	0000		0000	0000	5FHP	
11	5A28	5A28	5A28	5A28	5A28	U73F	5A28	5A28		0000	0000	5A28	5A28
12	5A28	5A28	5A28		0000	0000	5A28	5A28		5A28	5A28	0000	
13	5A28	0000	AF62		0000		5A28	0000		0000	0000	5A28	0000
14	5A28		AFH9		5A28	5A28		5A28	5A28	5A28	5A28	5A28	5A28
15			5A28				5A28						
16							5A28						
17							AH14						
18													
19							5A28						
20							5A28						

IC PIN	76	77	108	114	116	117	118	119	120	121	122	123
1	5A28	5A28		0000	449C	0000	5FHP	5A28		A13C	AH14	AH14
2	5A28	5A28	0000	AUAC	06U6		06U6	5A28		A56F	A56F	0000
3	0000	5A28	5A28	8161	5A28		0000	5A28	5A28	CF50	A13C	
4	0000	5A28	0000	9044	AH14	0000	5A28	5A28	5A28	0686	AH14	5A28
5	0000	5A28	0000	82P1	5A28	5A28	CF50	5A28	5A28	0000	5A28	5A28
6	5A28	0000	5A28	4F36	U73F	0686	P678	5A28	5A28	5A28	5A28	5A28
7	0000	0000	0000	5P15	0000	0000	0000	0000	0000	0000	5A28	5A28
8	5A28	5A28	0000	CFFU	5A28	1PC3	0000	5A28	5A28	5A28	0000	0000
9		0000	5A28	3U16	449C	0000	5A28	5A28	5A28	0000	5A28	5A28
10	0000	5A28	5A28	0000	5FHP	449C	U73F	5A28	5A28	0000	5A28	5A28
11	5A28	0000	0000		C807	A56F	AH14	5A28	5A28	5A28	5A28	5A28
12	0000	0000	0000	4CU3	AH14	A13C	0000	5A28	5A28	U73F	5A28	5A28
13	0000	5A28	5A28	A929	5A28	C807	5A28	5A28	5A28	P678	0686	5A28
14	5A28	5A28	5A28	CC0A	5A28	5A28	5A28	5A28	5A28	5A28	AF62	5A28
15				82P1							5A28	5A28
16				6778							5A28	5A28
17				765H								
18				5897								
19				U73F								
20				5A28								

8-7. TEST 20

Tested Point:

RAM TEST

Analyzer Setting:

CLOCK : ⌐ : Z-80 PIN 21 OR IC5 PIN 4
START : ⌐ : CN3 PIN 5
STOP : ⌐ : CN3 PIN 9

Jig Sw Setting:

SW1	SW2	SW3	SW4
CLOSE	OPEN	CLOSE	CLOSE

Check Point:

CHECK : IC17, IC18, IC19, IC20, IC21, IC22, IC23, IC24, IC25, IC26

IC PIN	17	18	19	20	21	22	23	24	25	26
1	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9
2	9423	UC36	855A	A003	C285	5CP1	805U	0H37	U57A	0ACF
3	98H0	222C	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9
4	98H0	222C	0000	0000	0000	0000	0000	0000	0000	0000
5	5U67	24P1	98H0	98H0	98H0	98H0	98H0	98H0	98H0	98H0
6	PA61	984F	C24F	C24F	C24F	C24F	C24F	C24F	C24F	C24F
7	PA61	984F	PA61	PA61	PA61	PA61	PA61	PA61	PA61	PA61
8	0000	0000	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9	U3F9
9	C24F	PC8H	5FP6	5FP6	5FP6	5FP6	5FP6	5FP6	5FP6	5FP6
10	C24F	PC8H	984F	984F	984F	984F	984F	984F	984F	984F
11	A4F7	6587	222C	222C	222C	222C	222C	222C	222C	222C
12	H664	5FP6	H664	H664	H664	H664	H664	H664	H664	H664
13	H664	5FP6	PC8H	PC8H	PC8H	PC8H	PC8H	PC8H	PC8H	PC8H
14	00H8	UCH8	855A	A003	C285	5CP1	805U	0H37	U57A	0ACF
15	0000	0000	AU2U	AU2U	AU2U	AU2U	AU2U	AU2U	AU2U	AU2U
16	U3F9	U3F9	0000	0000	0000	0000	0000	0000	0000	0000

8-8. TEST 30

Tested Point:
IC29 (CRTC) TEST

Analyzer Setting:
CLOCK : ↘ : IC2 PIN 4
START : ↗ : CN3 PIN 5
STOP : ↗ : CN3 PIN 19

Jig Sw Setting:

SW1	SW2	SW3	SW4
OPEN	OPEN	CLOSE	CLOSE

Connect the Jumper Wire:
CONNECT CN6 PIN 1 TO J6-1 (IC29 PIN 2)

Check Point:
CHECK : IC29, IC37, IC39, IC40, IC44, IC45, IC48, IC49, IC130, IC131

IC PIN	29	IC PIN	29	IC PIN	37	39	40	44	45	48	49	130	131
1	0000	21		1	CA95	744P	PHU4	0000	PHU4	356C	356C	46F1	0000
2	PHU4	22	9H36	2	A7C9	0000	0000	C0H6	PHU4	52U6	F291	0000	0000
3	0000	23	0000	3	H9H8	744P	0000	UFHU		0HUU	F291	FPF1	0000
4	A7C9	24	0000	4	9P74	744P	0000	6887	1134	8F61	PHU4	744P	46F1
5	1134	25	PHU4	5	2F18	PHU4	66A0	1UC5	F9AC	C347	0U52	370A	0000
6	0C2A	26	5CHF	6	CA95	99CA	0000	PHC0	0C2A	A42P	U4U2	0000	0000
7	F981	27	4415	7	UH1F	0000	0000	3H82	F281	PFU7	U8H8	UH1F	0000
8	862C	28	2UH1	8	0000	46F1	0000	63HH	0000	0000	0000	0000	0000
9	9053	29	88C7	9	0000	744P	66A0	7151	92H2	C58P	4H2F	A7C9	744P
10	UFHU	30	866P	10	0000	328U	66A0	0000	FPF6	A8U8	U172	58AC	328U
11	6887	31	HHU7	11	0000	PHU4	7CF3	92H2	F981	664U	664U	0000	HP61
12	3H82	32	6P33	12	0000	0000	7CF3	7412	29A1	0000	34H3	0000	A7C9
13	63HH	33	34A1	13	0000	PHU4	7CF3	AA54	862C	0000	H780	0000	0000
14	AA54	34	0000	14	0000	PHU4	2A0F	0000	9053	0000	0000	0000	9712
15	0000	35	0000	15	0000		0000	0000	P84P	7U26	7U26	0000	CPHF
16	0000	36	66A0	16	PHU4		PHU4	2P9C	PHU4	PHU4	PHU4	PHU4	PHU4
17	0000	37	7CF3	17				66A0					
18	0000	38	2A0F	18				7CF3					
19	0000	39	UH1F	19				3979					
20	PHU4	40	0000	20				PHU4					

8-9. TEST 31

Tested Point:

IC81 (C-RAM) TEST

Analyzer Setting:

CLOCK : ↘ : IC2 PIN 4
START : ↗ : CN3 PIN 5
STOP : ↗ : CN3 PIN 17

Jig Sw Setting:

SW1	SW2	SW3	SW4
OPEN	OPEN	CLOSE	CLOSE

Connect the Jumper Wire:

CONNECT CN6 PIN 1 TO J6-1 (IC29 PIN 2)

Check Point:

CHECK : IC78, IC79, IC80, IC81, IC83, IC84, IC85

IC PIN	78	79	80	81	83	84	85
1	0000	0000	0000	0FA7	0000	0000	0000
2	AA51	9A53		U716	F6H3		F7U2
3	414C	51H0		U992			F6H3
4	0FA7	3248	22FC	70C1			
5	0000	HC74	F94U	3248	25P2		2P23
6	U7C1	273C	22FC	6149	6A1A	F179	PA69
7	AH6U	70C1	6UFF	A212	A5C6		
8	0000	0000	0000	6UFF	5782		25P2
9	33AP	U992	A212	F6H3	55F6		95CA
10	0000	985H	33AP		0000	0000	0000
11	33AP	50A2	731C		8H50	8H50	22FC
12	0000	U716	6149	0000	8CF4	8CF4	HA92
13	0000	823U	UAP1	25P2	8910	8910	6A1A
14	0000	FH82	AF9H	6A1A	9UU2	9UU2	A5C6
15	0000	0000	0000	A5C6	80UA	80UA	2P7C
16	22FC	22FC	22FC	5782	F71P	F71P	9AHA
17				55F6	05H1	05H1	5782
18				0000	8979	8979	55F6
19				0000		22FC	23P4
20				22FC	22FC	22FC	22FC
21				22FC			
22				33AP			
23				AH6U			
24				22FC			

8-10. TEST 3 2

Tested Point:
IC82 (A-RAM) TEST

Analyzer Setting:
CLOCK : ⌥ : IC2 PIN 4
START : ⌐ : CN3 PIN 7
STOP : ⌐ : CN3 PIN 17

Jig Sw Setting:

SW1	SW2	SW3	SW4
OPEN	OPEN	CLOSE	CLOSE

Connect the Jumper Wire:
CONNECT CN6 PIN 1 TO J6-1 (IC29 PIN 2)

Check Point:
CHECK : IC78, IC79, IC80, IC82, IC83, IC84, IC97, IC98, IC99, IC100

IC PIN	78	79	80	82	83	84	97	98	99	100
1	0000	0000	0000	9800	0000	0000	0000	0000	0000	0000
2	AA51	9A53		690U	22FC	6052	69F3	69F3	U801	U801
3	FU0H	51H0		PH5C		31HH	6052	69F3	69F3	U801
4	9800	3248	22FC	H530		252C	31HH	40A9	40A9	631A
5	0000	HC74	UAP1	3248		30UP	40A9	40A9	631A	631A
6	33U7	F9C8	22FC	6149		75H3	82H2	82H2	H69P	H69P
7	0037	H530	5F62	9P9U		94F9	252C	82H2	82H2	H69P
8	0000	0000	0000	5F62		40A8	30UP	50C9	50C9	AU63
9	3FCA	PH5C	9P9U	6052			50C9	50C9	AU63	AU63
10	113F	96A9	1165	31HH	0000	0000	0000	0000	0000	0000
11	33AP	50A2	40C5	252C	8H50	8H50	22FC	22FC	22FC	0000
12	0000	690U	6149	0000	8CF4	8CF4	5176	5176	010F	010F
13	0000	13CA	F94U	30UP	8910	8910	75H3	5176	5176	010F
14	0000	FH82	AF9H	75H3	9UU2	9UU2	94F9	P603	P603	CF92
15	0000	0000	0000	94F9	80UA	80UA	P603	P603	CF92	CF92
16	22FC	22FC	22FC	4UA8	F71P	F71P	A56C	A56C	95U6	95U6
17					367U	367U	4UA8	A56C	A56C	95U6
18				0000	CAH7	CAH7		F1C1	F1C1	957C
19				0000	22FC	3F8H	F1C1	F1C1	957C	957C
20				22FC	22FC	22FC	22FC	22FC	22FC	22FC
21				22FC						
22				3FCA						
23				0037						
24				22FC						

8-11. TEST 33

Tested Point:
IC90 (PCG) TEST

Analyzer Setting:
CLOCK : ↘ : IC2 PIN 4
START : ↗ : CN3 PIN 9
STOP : ↗ : CN3 PIN 17

Jig Sw Setting:

SW1	SW2	SW3	SW4
OPEN	OPEN	CLOSE	CLOSE

Connect the Jumper Wire:
CONNECT CN6 PIN 1 TO J6-1 (IC29 PIN 2)

Check Point:
CHECK : IC87, IC88, IC89, IC90, IC91, IC92, IC93, IC94, IC95, IC96

IC PIN	87	88	89	90	91	92	93	94	95	96
1	0000	0000	0000	UF2H	0U23	0U23	22FC	0000	0000	0000
2	AA51	9A53		A8H6	A822	CAH7	CAH7	781H	972C	972C
3	637A	22FC		F963	1047	CAH7	CAH7	A822	781H	972C
4	UF2H	P341	22FC	9H7C	7541	05H1	05H1	1047	6CA7	3CCA
5	0000	HC74	UAP1	P341	7UP1	05H1	05H1	6CA7	3CCA	3CCA
6	UF0H	1165	U0PF	UC47	27UU	U4C0	U4C0	695P	F4HC	F4HC
7	4561	9H7C	PH80	9C7F	A14F	U4C0	U4C0	7541	695P	F4HC
8	0000	0000	0000	PH80	52UA	80UA	80UA	7UP1	P729	9C81
9	A5H0	F963	9C7F	A822	68UC	80UA	80UA	P729	9C81	9C81
10	CA82	F94U	781H	1047	0000	0000	0000	0000	0000	0000
11	33AP	50A2	731C	7541	8H50	22FC	0000	22FC	22FC	0000
12	78HF	A8H6	UC47	0000	8CF4	9UU2	9UU2	6816	626F	626F
13	CAFA	51H0	0000	7UP1	8910	9UU2	9UU2	27UU	6816	626F
14	0000	FH82	9U33	27UU	9UU2	8910	8910	A14F	H903	7C1C
15	0000	0000	0000	A14F	80UA	8910	8910	H903	7C1C	7C1C
16	22FC	22FC	22FC	52UA	U4C0	8CF4	8CF4	4221	F7FU	F7FU
17				68UC	05H1	8CF4	8CF4	52UA	4221	F7FU
18				0000	CAH7	8H50	8H50	68UC	79AF	2H15
19				78HF	3F8H	8H50	8H50	79AF	2H15	2H15
20				22FC	22FC	22FC	22FC	22FC	22FC	22FC
21				22FC						
22				A5H0						
23				4561						
24				22FC						

8-12. TEST 3 4

Tested Point:
G-RAM TEST

Analyzer Setting:
CLOCK : ↘ : IC2 PIN 4
START : ↗ : CN3 PIN 11
STOP : ↗ : CN3 PIN 17

Jig Sw Setting:

SW1	SW2	SW3	SW4
OPEN	OPEN	CLOSE	CLOSE

Connect the Jumper Wire:
CONNECT CN6 PIN 1 TO J6-1 (IC29 PIN 2)

Check Point:
CHECK : IC50, IC53 ~ IC68, IC69, IC70, IC86, IC101, IC102, IC103, IC104

IC PIN	50	53	54	55	56	57	58	59	60	61	62	63	64
1	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
2	PFH1	HFPC	P03P	C6U4	HAC4	954H	UH16	H45U	8C9P	HFPC	P03P	C6U4	HAC4
3	0000	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0
4	PFH1	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
5	4U4H	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F
6	H9A0	6158	6158	6158	6158	6158	6158	6158	6158	6158	6158	6158	6158
7	0000	75A5	75A5	75A5	75A5	75A5	75A5	75A5	75A5	75A5	75A5	75A5	75A5
8	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0
9	3CP1	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0	H9A0
10	0000	PUPF	PUPF	PUPF	PUPF	PUPF	PUPF	PUPF	PUPF	PUPF	PUPF	PUPF	PUPF
11	H9A0	51CF	51CF	51CF	51CF	51CF	51CF	51CF	51CF	51CF	51CF	51CF	51CF
12	H9A0	14UF	14UF	14UF	14UF	14UF	14UF	14UF	14UF	14UF	14UF	14UF	14UF
13	96PH	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
14	H9A0	P20C	UP83	C077	FU66	U5H7	4F4A	UA14	C07P	963H	0767	8H29	67CH
15		FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F	FH5F
16		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
17													
18													
19													
20													

IC PIN	65	66	67	68	69	70	86	101	102	103	104
1	0000	0000	0000	0000	H9A0	H9A0	FH5F	H9A0	FH5F	H9A0	FH5F
2	954H	UH16	H45U	8C9P	8C9P	8C9P	0000	AH0P	AH0P	3127	3127
3	H9A0	H9A0	H9A0	H9A0	9H02	C07P	H9A0	9H02	9H02	C07P	C07P
4	0000	0000	0000	0000	9276	UA14	H9A0	9276	9276	UA14	UA14
5	FH5F	FH5F	FH5F	FH5F	H45U	H45U	H9A0	P49A	P49A	5HA1	5HA1
6	6158	6158	6158	6158	UH16	UH16	0000	7U34	7U34	3U9H	3U9H
7	75A5	75A5	75A5	75A5	54C4	4F4A	0000	54C4	54C4	4F4A	4F4A
8	H9A0	H9A0	H9A0	H9A0	84C7	U5H7	FH5F	84C7	84C7	U5H7	U5H7
9	H9A0	H9A0	H9A0	H9A0	954H	954H	H9A0	HA78	HA78	0400	0400
10	PUPF	PUPF	PUPF	PUPF	0000	0000	H9A0	0000	0000	0000	0000
11	51CF	51CF	51CF	51CF	FH5F	FH5F	H9A0	FH5A	FH5A	FH5F	FH5F
12	14UF	14UF	14UF	14UF	HAC4	HAC4	H9A0	45U6	45U6	1A36	1A36
13	0000	0000	0000	0000	67CH	FU66	0000	67CH	67CH	FU66	FU66
14	84C7	54C4	9276	9H02	8H29	C077	H9A0	8H29	8H29	C077	C077
15	FH5F	FH5F	FH5F	FH5F	C6U4	C6U4		269C	269C	26P4	26P4
16	0000	0000	0000	0000	P03P	P03P		5C4U	5C4U	CH8A	CH8A
17					0767	UP83		0767	0767	UP83	UP83
18					963H	P20C		963H	963H	P20C	P20C
19					HFPC	HFPC		1940	1940	1150	1150
20					H9A0	H9A0		H9A0	H9A0	H9A0	H9A0

SECTION 9
ALIGNMENT

9-1. CPU CLOCK ADJUSTMENT

Equipment Required : Frequency Counter
Check Point : L7/PU-4
Specification : 8.055950 MHz ± 100 Hz
Adjustment : C11/PU-4

9-2. CALENDER/CLOCK ADJUSTMENT

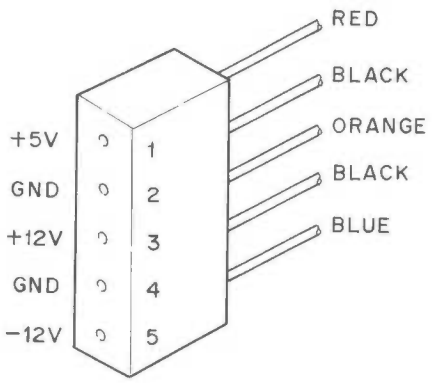
Equipment Required : Frequency Counter
Check point : TP203/IF-30
Specification : 1.000000 ± 0.000002 sec
Adjustment : C215/IF-30

9-3. POWER VOLTAGE ADJUSTMENT

- Check that the conditions ① and ② described below meet the specification and adjust them according to requirements.
- Conditions

Conditions	Input (V)	Output load (Ω)		
		+5V system	+12V system	−12V system
①	120	2.5	7.5	120
②	120	1.0	30.0	∞ (OPEN)

- Check point: Switching regulator output connector



- Specifications: +5V (+5.25V ~ +4.85V)
  +12V (+12.96V ~ +11.64V)
  −12V(−12.96V ~ −11.04V)
- Adjustment: RV101/PK-5 board

Note: +5V and +12V can be adjusted using the RV101.
−12V can not be adjusted because of the 3-pin Reg included.

No.	Parts No.	Description
1	A-8030-049-A	CABINET (UPPER) ASSY
2	A-8040-007-A	KEY BOARD ASSY
3	X-4603-204-0	SUPPORT (LEFT) ASSY, CABINET (S/N UP TO 11300)
	X-4603-204-4	SUPPORT (LEFT) ASSY, CABINET (S/N 11301 AND HIGHER)
4	X-4603-205-0	SUPPORT (RIGHT) ASSY, CABINET (S/N UP TO 11300)
	X-4603-205-4	SUPPORT (RIGHT) ASSY, CABINET (S/N 11301 AND HIGHER)
5	X-4603-208-0	PANEL ASSY, KB
6	**1-933-648-00**	**HARNESS (KB)**
7	2-246-108-00	CUSHION
8	4-603-272-00	SPACER (1)
9	4-603-273-00	BRACKET, SWITCH
10	**4-603-280-01**	**SCREW, LOCK**
11	**4-603-280-11**	**SCREW, LOCK**
12	4-603-287-00	RUBBER, SHOCK ABSORBING
13	4-603-288-00	ROD, SPRING
14	4-603-289-00	LEVER
15	4-603-291-00	KEY TOP, RESET
16	4-603-298-00	SHAFT, GUIDE
17	4-603-299-00	BEARING
18	4-603-301-01	KEY TOP (1)
19	4-603-301-02	KEY TOP (1)
20	4-603-301-03	KEY TOP (1)
21	4-603-301-04	KEY TOP (1)
22	4-603-301-05	KEY TOP (1)
23	4-603-301-06	KEY TOP (1)
24	4-603-302-01	KEY TOP (2)
25	4-603-302-02	KEY TOP (2)
26	4-603-302-03	KEY TOP (2)
27	4-603-302-04	KEY TOP (2)
28	4-603-302-05	KEY TOP (2)
29	4-603-302-06	KEY TOP (2)
30	4-603-302-07	KEY TOP (2)
31	4-603-302-08	KEY TOP (2)
32	4-603-302-09	KEY TOP (2)
33	4-603-302-10	KEY TOP (2)
34	4-603-302-11	KEY TOP (2)
35	4-603-302-12	KEY TOP (2)
36	4-603-302-13	KEY TOP (2)
37	4-603-302-14	KEY TOP (2)
38	4-603-302-15	KEY TOP (2)
39	4-603-302-16	KEY TOP (2)
40	4-603-302-17	KEY TOP (2)
41	4-603-302-18	KEY TOP (2)
42	4-603-303-01	KEY TOP (3)
43	4-603-303-02	KEY TOP (3)
44	4-603-303-03	KEY TOP (3)
45	4-603-303-04	KEY TOP (3)
46	4-603-303-05	KEY TOP (3)
47	4-603-303-06	KEY TOP (3)
48	4-603-303-07	KEY TOP (3)
49	4-603-303-08	KEY TOP (3)
50	4-603-303-09	KEY TOP (3)
51	4-603-303-10	KEY TOP (3)
52	4-603-303-11	KEY TOP (3)
53	4-603-303-12	KEY TOP (3)
54	4-603-303-13	KEY TOP (3)
55	4-603-303-14	KEY TOP (3)
56	4-603-304-00	KEY TOP (4)
57	4-603-305-00	KEY TOP (5)
58	4-603-306-00	KEY TOP (6)
59	4-603-307-01	KEY TOP (7)
60	4-603-307-02	KEY TOP (7)
61	4-603-307-03	KEY TOP (7)
62	4-603-307-04	KEY TOP (7)
63	4-603-307-05	KEY TOP (7)
64	4-603-307-06	KEY TOP (7)
65	4-603-307-07	KEY TOP (7)
66	4-603-307-08	KEY TOP (7)
67	4-603-307-09	KEY TOP (7)
68	4-603-307-10	KEY TOP (7)
69	4-603-308-00	KEY TOP (8)
70	4-603-309-01	KEY TOP (9)
71	4-603-309-02	KEY TOP (9)
72	4-603-309-03	KEY TOP (9)
73	4-603-309-04	KEY TOP (9)
74	4-603-309-05	KEY TOP (9)
75	4-603-309-06	KEY TOP (9)
76	4-603-309-07	KEY TOP (9)
77	4-603-309-08	KEY TOP (9)
78	4-603-309-09	KEY TOP (9)
79	4-603-309-10	KEY TOP (9)
80	4-603-309-11	KEY TOP (9)
81	4-603-309-12	KEY TOP (9)
82	4-603-309-13	KEY TOP (9)
83	4-603-310-00	KEY TOP (10)
84	4-603-311-01	KEY TOP (11)
85	4-603-311-02	KEY TOP (11)
86	4-603-318-00	SPACER (2)
87	4-603-338-00	SHEET, INSULATING, KEY BOARD
88	**1-246-423-00**	**RES, CARBON 8.2**
89	**1-507-285-00**	**JACK**
90	**1-516-781-XX**	**SLIDE SWITCH**
91	1-556-466-00	CABLE ASS'Y

NOTE:

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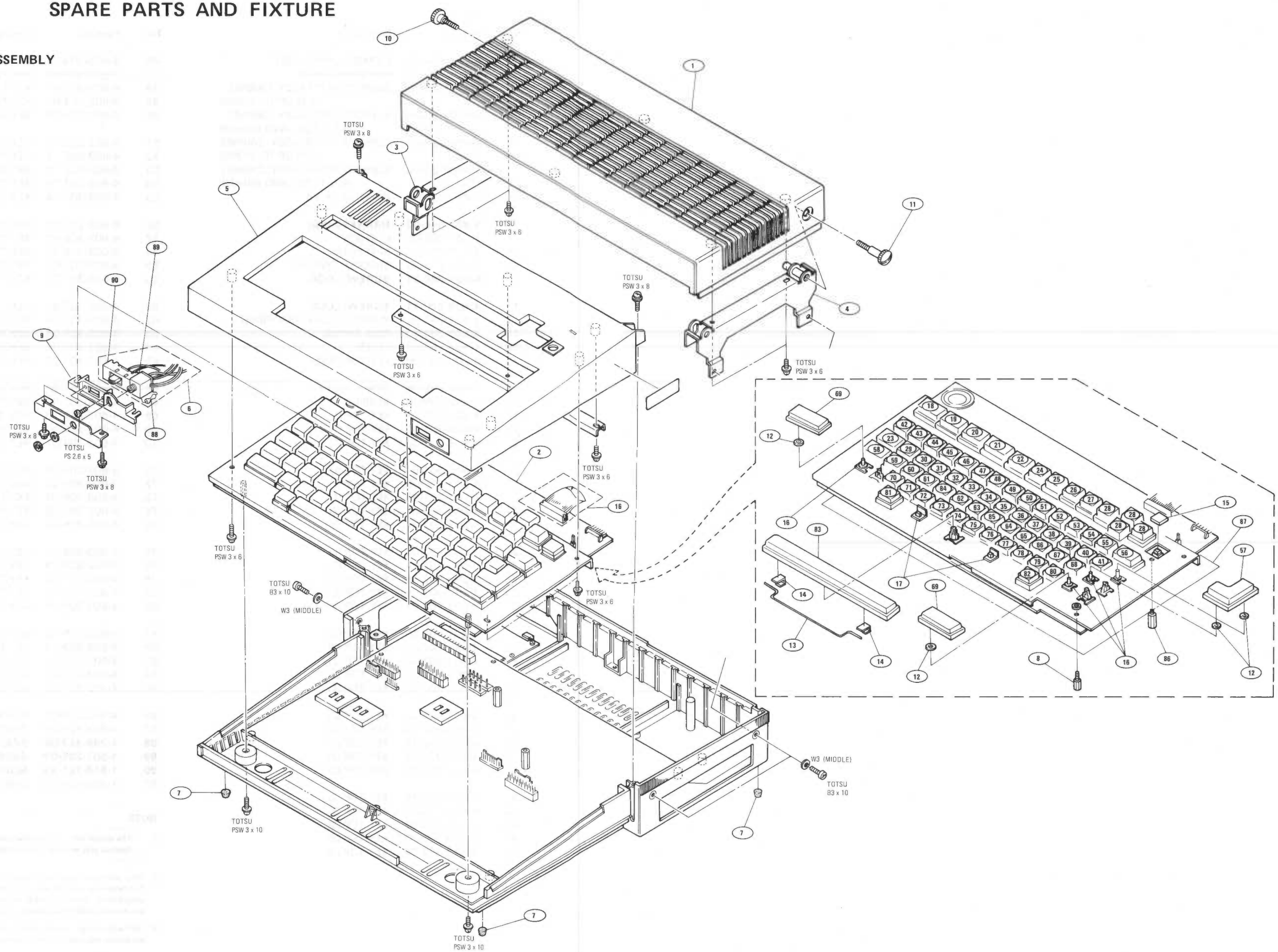
3. Item with no part number and/or no description are not stocked because they are seldom required for routine service.

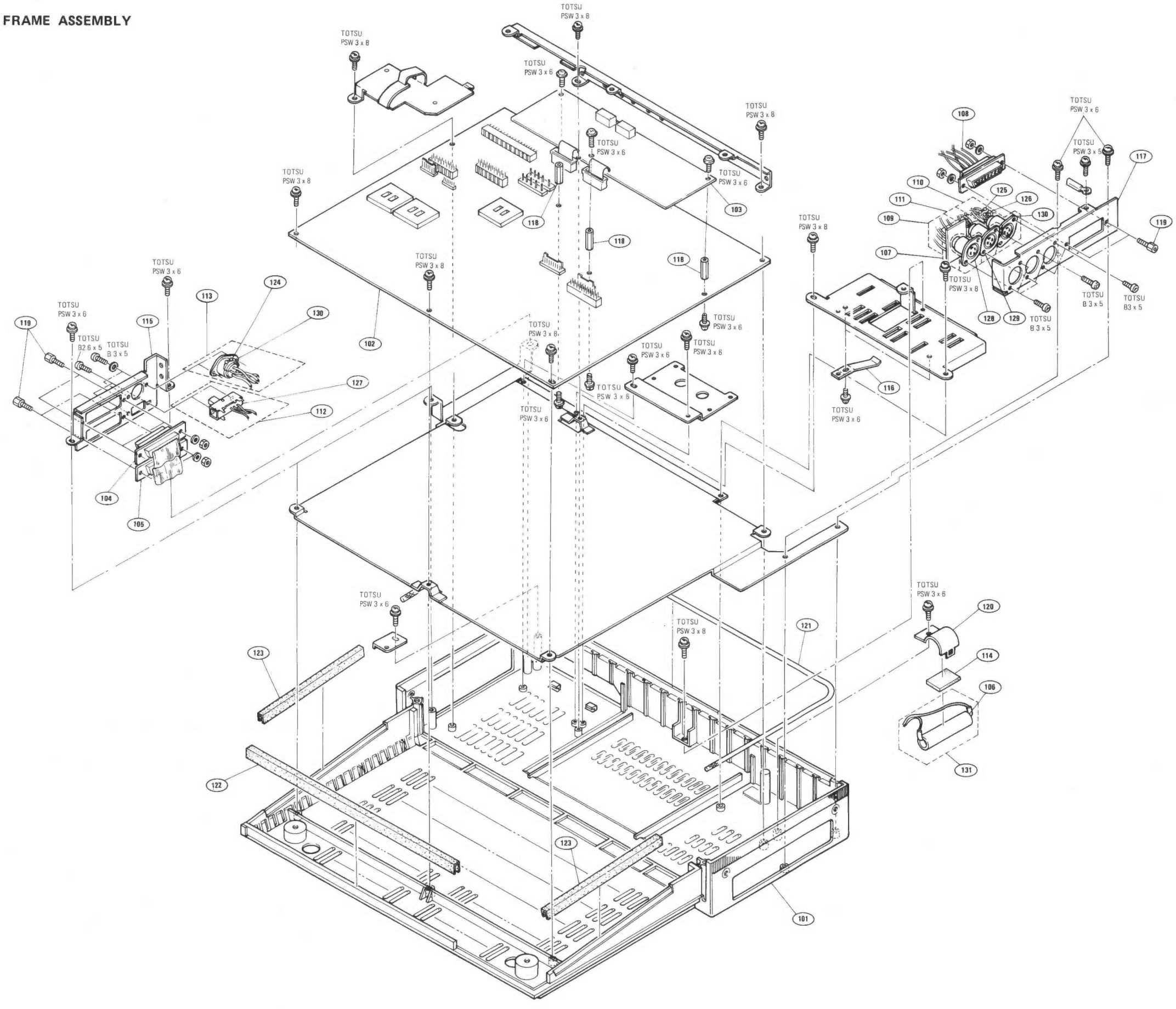
SECTION 10
SPARE PARTS AND FIXTURE

10-1. EXPLODED VIEW

CABINET, KEY BOARD ASSEMBLY


TOTSU PSW 3 x 8
TOTSU PSW 3 x 6
TOTSU PSW 3 x 8
TOTSU PSW 3 x 6
TOTSU PSW 3 x 6
TOTSU PSW 3 x 8
TOTSU PS 2.6 x 5
TOTSU PSW 3 x 8
TOTSU PSW 3 x 6
TOTSU PSW 3 x 6
TOTSU 83 x 10
W3 (MIDDLE)
TOTSU PSW 3 x 10
W3 (MIDDLE)
TOTSU 83 x 10
TOTSU PSW 3 x 10

FRAME ASSEMBLY



No.	Parts No.	Description
101	A-8030-044-A	CABINET (LOWER) ASSY
102	A-8051-018-B	COMPLETE PCB, MAIN
103	A-8051-019-B	COMPLETE PCB, SUB
104	**1-556-494-00**	**CABLE ASSY, PRINTER**
105	**1-556-495-00**	**CABLE ASSY, RGB**
106	**1-528-096-21**	**BATTERY, CADMIUM, NICKEL**
107	**1-608-343-00**	**PC BOARD, CN-61**
108	**1-933-647-00**	**HARNESS (RS)**
109	**1-933-649-00**	**HARNESS (KP)**
110	**1-933-650-00**	**HARNESS (CA)**
111	**1-933-651-00**	**HARNESS (LP)**
112	**1-933-652-00**	**HARNESS (TK)**
113	**1-933-653-12**	**HARNESS (BW)**
114	**3-487-042-00**	**CUSHION**
115	4-603-269-00	BRACKET, L CONNECTOR (S/N UP TO 11300)
	4-603-269-04	BRACKET, L CONNECTOR (S/N 11301 AND HIGHER)
116	4-603-267-00	SPRING
117	4-603-268-00	BRACKET, R CONNECTOR (S/N UP TO 11300)
	4-603-268-04	BRACKET,R CONNECTOR (S/N 11301 AND HIGHER)
118	4-603-274-00	SUPPORT, SUB
119	4-603-275-11	SCREW, LOCK
120	4-603-281-00	HOLDER, BT
121	4-603-343-00	RUBBER, BLADE
122	4-603-344-01	PACKING, RUBBER, CONDUCTIVE
123	4-603-344-11	PACKING, RUBBER, CONDUCTIVE
124	**1-102-973-00**	**CAP, CERAMIC 100PF SL**
125	**1-246-449-00**	**RES, CARBON 100**
126	**1-246-497-00**	**RES, CARBON 10K**
127	**1-514-552-21**	**SLIDE SWITCH**
128	**1-562-090-00**	**JACK 13P**
129	**1-562-091-00**	**JACK, DIN 5P**
130	**1-562-092-00**	**JACK, DIN 8P**
131	**1-933-566-00**	**HARNESS (BATTERY)**

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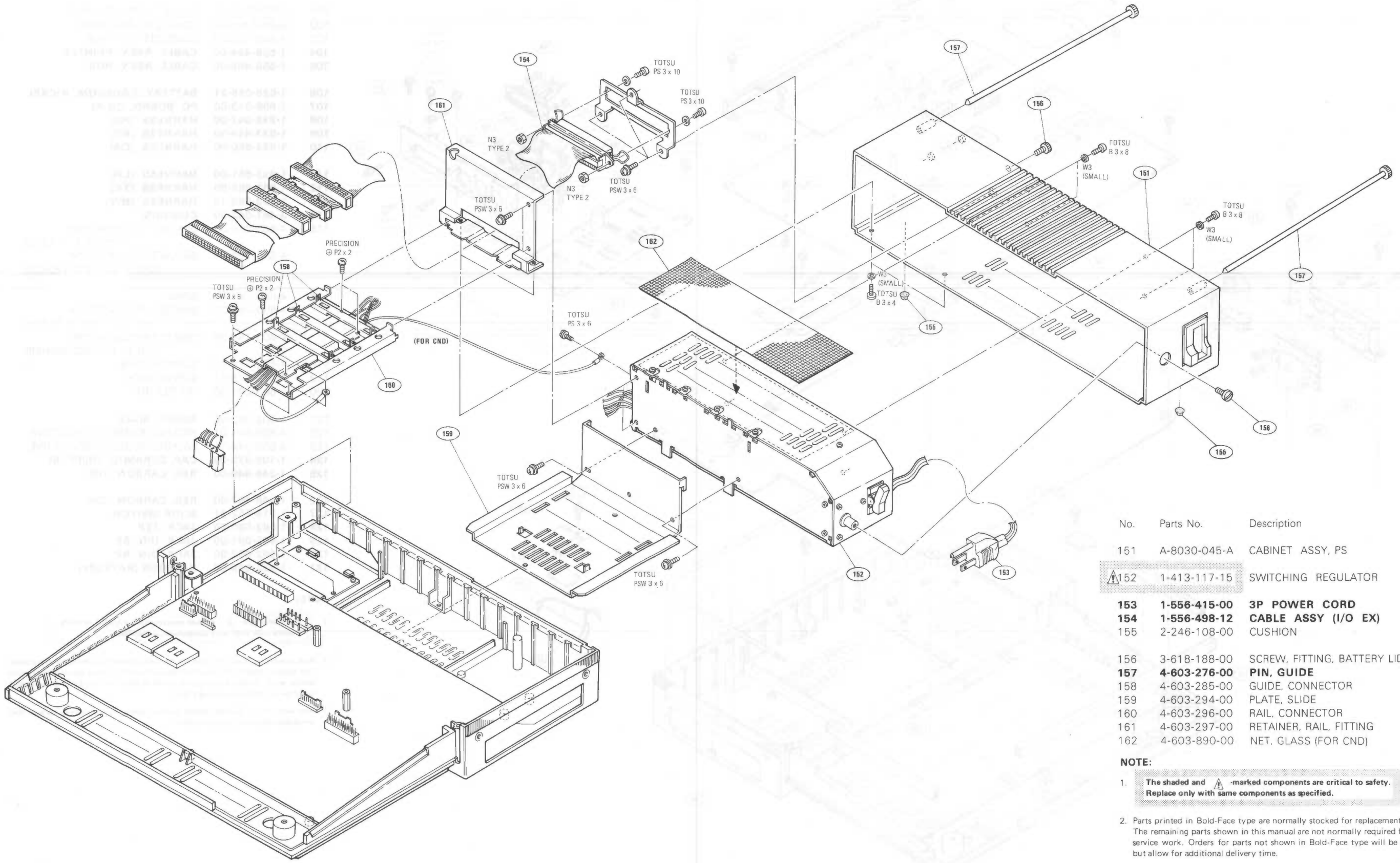
MAIN ASSEMBLY



No.	Parts No.	Description
151	A-8030-045-A	CABINET ASSY, PS
⚠152	1-413-117-15	SWITCHING REGULATOR
153	**1-556-415-00**	**3P POWER CORD**
154	**1-556-498-12**	**CABLE ASSY (I/O EX)**
155	2-246-108-00	CUSHION
156	3-618-188-00	SCREW, FITTING, BATTERY LID
157	**4-603-276-00**	**PIN, GUIDE**
158	4-603-285-00	GUIDE, CONNECTOR
159	4-603-294-00	PLATE, SLIDE
160	4-603-296-00	RAIL, CONNECTOR
161	4-603-297-00	RETAINER, RAIL, FITTING
162	4-603-890-00	NET, GLASS (FOR CND)

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10-2. ELECTRICAL PARTS LIST

Ref. No.	Parts No.	Description
PU-4 BOARD		
	A-8051-018-B	COMPLETE PCB, MAIN
C1	1-123-322-00	ELECT 330 20% 16V
C2	1-123-617-00	ELECT 10 20% 16V
C3	1-123-617-00	ELECT 10 20% 16V
C4	1-123-617-00	ELECT 10 20% 16V
C5	1-161-025-00	CERAMIC 0.1 12V
C6	1-161-013-00	CERAMIC 0.01 10% 25V
C7	1-123-369-00	ELECT 4.7 20% 25V
C8	1-161-307-00	CERAMIC 33PF 5% 50V
C9	1-161-173-00	CERAMIC 0.001 5% 25V
C10	1-102-518-00	CERAMIC 33PF 5% 50V
C11	1-101-983-00	CERAMIC 47PF 5% 50V (UP TO S/N 10100)
	1-102-520-00	CAP, CERAMIC 39PF CH (S/N 10101 AND HIGHER)
C12	1-161-025-00	CERAMIC 0.1 12V
C13	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C14	1-161-025-00	CERAMIC 0.1 12V
C15	1-161-025-00	CERAMIC 0.1 12V
C16	1-161-025-00	CERAMIC 0.1 12V
C17	1-161-025-00	CERAMIC 0.1 12V
C18	1-161-025-00	CERAMIC 0.1 12V
C19	1-161-025-00	CERAMIC 0.1 12V
C20	1-161-025-00	CERAMIC 0.1 12V
C21	1-161-025-00	CERAMIC 0.1 12V
C22	1-161-025-00	CERAMIC 0.1 12V
C25	1-161-025-00	CERAMIC 0.1 12V
C26	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C27	1-161-025-00	CERAMIC 0.1 12V
C28	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C29	1-123-612-00	ELECT 2.2 20% 50V
C31	1-123-617-00	ELECT 10 20% 16V
C32	1-123-617-00	ELECT 10 20% 16V
C33	1-161-025-00	CERAMIC 0.1 12V
C34	1-161-025-00	CERAMIC 0.1 12V
C35	1-161-025-00	CERAMIC 0.1 12V
C36	1-161-025-00	CERAMIC 0.1 12V
C37	1-161-025-00	CERAMIC 0.1 12V
C38	1-161-025-00	CERAMIC 0.1 12V
C39	1-161-025-00	CERAMIC 0.1 12V
C40	1-161-025-00	CERAMIC 0.1 12V
C41	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C42	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C43	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C44	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C45	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C46	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C47	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C48	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C49	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C50	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C51	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C52	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C53	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C54	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C55	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C56	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C57	1-161-025-00	CERAMIC 0.1 12V
C58	1-161-025-00	CERAMIC 0.1 12V
C59	1-161-025-00	CERAMIC 0.1 12V
C60	1-161-025-00	CERAMIC 0.1 12V
C61	1-161-025-00	CERAMIC 0.1 12V
C62	1-161-025-00	CERAMIC 0.1 12V
C63	1-161-025-00	CERAMIC 0.1 12V
C64	1-161-025-00	CERAMIC 0.1 12V
C65	1-161-025-00	CERAMIC 0.1 12V
C66	1-161-025-00	CERAMIC 0.1 12V
C67	1-161-025-00	CERAMIC 0.1 12V
C68	1-161-025-00	CERAMIC 0.1 12V
C69	1-161-025-00	CERAMIC 0.1 12V
C70	1-161-025-00	CERAMIC 0.1 12V
C71	1-161-025-00	CERAMIC 0.1 12V
C72	1-161-025-00	CERAMIC 0.1 12V
C73	1-161-025-00	CERAMIC 0.1 12V
C74	1-161-025-00	CERAMIC 0.1 12V
C75	1-161-025-00	CERAMIC 0.1 12V
C76	1-161-025-00	CERAMIC 0.1 12V
C77	1-161-025-00	CERAMIC 0.1 12V
C78	1-161-025-00	CERAMIC 0.1 12V
C79	1-161-025-00	CERAMIC 0.1 12V
C80	1-161-025-00	CERAMIC 0.1 12V
C81	1-161-025-00	CERAMIC 0.1 12V
C82	1-161-025-00	CERAMIC 0.1 12V
C83	1-161-025-00	CERAMIC 0.1 12V

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Ref. No.	Parts No.	Description
C84	1-161-025-00	CERAMIC 0.1 12V
C85	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C86	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C87	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C88	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C89	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C90	1-127-480-00	ELECT (SOLID) 0.33 20% 16V
C91	1-102-973-00	CERAMIC 100PF 5% 50V
C92	1-102-973-00	CERAMIC 100PF 5% 50V
CN1	1-560-471-00	PIN, CONNECTOR 10P
CN2	1-560-652-00	PIN, CONNECTOR 14P
CN3	1-560-921-00	CONNECTOR, P (DIP TYPE) 26P
CN4	1-560-467-00	PIN, CONNECTOR 4P
CN5	1-560-470-00	PIN, CONNECTOR 8P
CN6	1-560-921-00	CONNECTOR, P (DIP TYPE) 26P
CN7	1-560-982-00	CONNECTOR, P (DIP TYPE) 26P
CN8	1-560-911-00	PLUG, CONNECTOR 5P
CN9	1-560-911-00	PLUG, CONNECTOR 5P
CN10	1-562-040-00	CONNECTOR, P 50P
CN11	1-560-466-00	PIN, CONNECTOR 3P
D1	8-719-911-19	DIODE 1SS119
D2	8-719-911-19	DIODE 1SS119
D3	8-719-911-19	DIODE 1SS119
D4	8-719-911-19	DIODE 1SS119
D5	8-719-911-19	DIODE 1SS119
D6	8-719-911-19	DIODE 1SS119
D7	8-719-911-19	DIODE 1SS119
D8	8-719-911-19	DIODE 1SS119
D9	8-719-911-19	DIODE 1SS119
D10	8-719-911-19	DIODE 1SS119
D11	8-719-911-19	DIODE 1SS119
D12	8-719-911-19	DIODE 1SS119
D13	8-719-911-19	DIODE 1SS119
D14	8-719-911-19	DIODE 1SS119

Ref. No.	Parts No.	Description
IC1	8-759-910-74	IC SN74S74N
IC2	8-759-900-02	IC SN74LS02N
IC3	8-759-910-04	IC SN74S04N (U: UP TO S/N 10100)
	8-759-910-00	IC SN74S00N (U: S/N 10101 AND HIGHER)
IC4	8-759-045-84	IC MC14584BCP
IC5	8-759-903-67	IC 74LS367AN
IC6	8-759-900-09	IC SN74LS09N
IC7	8-759-179-05	IC μPC7905H
IC8	8-759-916-80	IC LH0080A
IC9	8-759-903-67	IC 74LS367AN
IC10	8-759-903-67	IC 74LS367AN
IC11	8-759-903-67	IC 74LS367AN
IC12	8-759-902-45	IC SN74LS245N
IC13	8-759-910-00	IC SN74S00N (U: UP TO S/N 10100)
	8-759-900-00	IC SN74LS00N (U: S/N 10101 AND HIGHER)
IC14	8-759-900-08	IC SN74LS08N
IC15	8-759-901-39	IC SN74LS139N
IC16	8-759-905-64	IC CX10015
IC17	8-759-911-57	IC SN74S157N
IC18	8-759-911-57	IC SN74S157N
IC19	8-759-905-75	IC MSM376415R
IC20	8-759-905-75	IC MSM376415R
IC21	8-759-905-75	IC MSM376415R
IC22	8-759-905-75	IC MSM376415R
IC23	8-759-905-75	IC MSM376415R
IC24	8-759-905-75	IC MSM376415R
IC25	8-759-905-75	IC MSM376415R
IC26	8-759-905-75	IC MSM376415R
IC27	8-759-101-05	IC μPD23128C-114
IC28	8-759-101-06	IC μPD23128C-115
IC29	8-759-365-05	IC HD46505SP1
IC30	8-759-900-04	IC SN74LS04N
IC31	8-759-902-44	IC SN74LS244N
IC32	8-759-903-74	IC SN74LS374N
IC33	8-759-901-75	IC SN74LS175N
IC34	8-759-904-18	IC SN74ALS00N
IC35	8-759-904-14	IC SN74ALS04N
IC36	8-759-900-00	IC SN74LS00N
IC37	8-759-245-20	IC TC4520BP
IC38	8-759-900-05	IC SN74LS05N
IC39	8-759-900-86	IC SN74LS86N
IC40	8-759-911-57	IC SN74S157N
IC41	8-759-903-74	IC SN74LS374N
IC42	8-759-900-04	IC SN74LS04N
IC43	8-759-900-00	IC SN74LS00N
IC44	8-759-903-74	IC SN74LS374N
IC45	8-759-901-74	IC SN74LS174N

NOTE:

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Ref. No.	Parts No.	Description
IC46	8-759-902-57	IC 74LS257AN
IC47	8-759-902-57	IC 74LS257AN
IC48	8-759-902-57	IC 74LS257AN
IC49	8-759-902-57	IC 74LS257AN
IC50	8-759-900-10	IC SN74LS10N
IC51	8-759-900-74	IC SN74LS74AN
IC52	8-759-900-74	IC SN74LS74AN
IC53	8-759-981-16	IC MB8116H
IC54	8-759-981-16	IC MB8116H
IC55	8-759-981-16	IC MB8116H
IC56	8-759-981-16	IC MB8116H
IC57	8-759-981-16	IC MB8116H
IC58	8-759-981-16	IC MB8116H
IC59	8-759-981-16	IC MB8116H
IC60	8-759-981-16	IC MB8116H
IC61	8-759-981-16	IC MB8116H
IC62	8-759-981-16	IC MB8116H
IC63	8-759-981-16	IC MB8116H
IC64	8-759-981-16	IC MB8116H
IC65	8-759-981-16	IC MB8116H
IC66	8-759-981-16	IC MB8116H
IC67	8-759-981-16	IC MB8116H
IC68	8-759-981-16	IC MB8116H
IC69	8-759-903-74	IC SN74LS374N
IC70	8-759-903-74	IC SN74LS374N
IC71	8-759-900-04	IC SN74LS04N
IC72	8-759-900-10	IC SN74LS10N
IC73	8-759-900-10	IC SN74LS10N
IC74	8-759-900-32	IC SN74LS32N
IC75	8-759-900-02	IC SN74LS02N
IC76	8-759-900-00	IC SN74LS00N
IC77	8-759-910-74	IC SN74S74N
IC78	8-759-901-57	IC SN74LS157N
IC79	8-759-901-57	IC SN74LS157N
IC80	8-759-901-57	IC SN74LS157N
IC81	8-759-600-30	IC M58725P
IC82	8-759-600-30	IC M58725P
IC83	8-759-902-45	IC SN74LS245N
IC84	8-759-902-45	IC SN74LS245N
IC85	8-759-903-74	IC SN74LS374N
IC86	8-759-900-00	IC SN74LS00N
IC87	8-759-901-57	IC SN74LS157N
IC88	8-759-901-57	IC SN74LS157N
IC89	8-759-901-57	IC SN74LS157N
IC90	8-759-600-30	IC M58725P

Ref. No.	Parts No.	Description
IC91	8-759-902-45	IC SN74LS245N
IC92	8-759-903-74	IC SN74LS374N
IC93	8-759-903-74	IC SN74LS374N
IC94	8-759-903-74	IC SN74LS374N
IC95	8-759-903-74	IC SN74LS374N
IC96	8-759-903-74	IC SN74LS374N
IC97	8-759-903-74	IC SN74LS374N
IC98	8-759-903-74	IC SN74LS374N
IC99	8-759-903-74	IC SN74LS374N
IC100	8-759-903-74	IC SN74LS374N
IC101	8-759-903-74	IC SN74LS374N
IC102	8-759-903-74	IC SN74LS374N
IC103	8-759-903-74	IC SN74LS374N
IC104	8-759-903-74	IC SN74LS374N
IC105	8-759-905-65	IC CX10016
IC106	8-759-905-66	IC CX10017
IC107	8-759-900-03	IC SN74LS03N
IC108	8-759-900-04	IC SN74LS04N
IC109	8-759-900-20	IC SN74LS20N
IC110	8-759-974-05	IC SN7405N
IC111	8-759-903-67	IC 74LS367AN
IC112	8-759-903-67	IC 74LS367AN
IC113	8-759-903-67	IC 74LS367AN
IC114	8-759-902-45	IC SN74LS245N
IC115	8-759-903-67	IC 74LS367AN
IC116	8-759-900-10	IC SN74LS10N
IC117	8-759-900-02	IC SN74LS02N
IC118	8-759-900-04	IC SN74LS04N
IC119	8-759-900-32	IC SN74LS32N
IC120	8-759-900-32	IC SN74LS32N
IC121	8-759-900-00	IC SN74LS00N
IC122	8-759-901-39	IC SN74LS139N
IC123	8-759-902-59	IC SN74LS259AN
IC124	8-759-900-74	IC SN74LS74AN
IC125	8-759-900-74	IC SN74LS74AN
IC126	8-759-900-74	IC SN74LS74AN
IC127	8-759-900-74	IC SN74LS74AN
IC128	8-759-900-32	IC SN74LS32N
IC129	8-759-902-57	IC 74LS257AN
IC130	8-759-240-15	IC TC4015BP
IC131	8-759-345-17	IC HD14517BP
J5-3	1-560-914-00	POST, CONNECTOR 2P
J5	1-560-915-00	POST, CONNECTOR 7P

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Ref. No.	Parts No.	Description
L1	1-543-190-00	BEAD, FERRITE
L2	1-543-190-00	BEAD, FERRITE
L3	1-543-190-00	BEAD, FERRITE
L4	1-543-184-00	BEAD, FERRITE
L5	1-543-184-00	BEAD, FERRITE
L6	1-543-184-00	BEAD, FERRITE
L7	1-543-184-00	BEAD, FERRITE
L8	1-543-184-00	BEAD, FERRITE
L9	1-543-184-00	BEAD, FERRITE
L10	1-543-184-00	BEAD, FERRITE
L11	1-543-184-00	BEAD, FERRITE
L12	1-543-184-00	BEAD, FERRITE
L13	1-543-184-00	BEAD, FERRITE
L14	1-543-184-00	BEAD, FERRITE
L15	1-543-184-00	BEAD, FERRITE
L16	1-543-184-00	BEAD, FERRITE
L17	1-543-184-00	BEAD, FERRITE
L18	1-543-184-00	BEAD, FERRITE
L19	1-543-184-00	BEAD, FERRITE
L20	1-543-184-00	BEAD, FERRITE
L21	1-543-184-00	BEAD, FERRITE
L22	1-543-184-00	BEAD, FERRITE
L23	1-543-184-00	BEAD, FERRITE
L24	1-543-184-00	BEAD, FERRITE
L25	1-543-184-00	BEAD, FERRITE
L26	1-543-184-00	BEAD, FERRITE
L27	1-543-184-00	BEAD, FERRITE
L28	1-543-184-00	BEAD, FERRITE
L29	1-543-184-00	BEAD, FERRITE
L30	1-543-184-00	BEAD, FERRITE
L31	1-543-184-00	BEAD, FERRITE
L32	1-543-184-00	BEAD, FERRITE
L33	1-543-184-00	BEAD, FERRITE
L34	1-543-184-00	BEAD, FERRITE
L35	1-543-184-00	BEAD, FERRITE
L36	1-543-184-00	BEAD, FERRITE
L37	1-543-184-00	BEAD, FERRITE
L38	1-543-184-00	BEAD, FERRITE
L39	1-543-184-00	BEAD, FERRITE
L40	1-543-184-00	BEAD, FERRITE
L41	1-543-184-00	BEAD, FERRITE
L42	1-543-184-00	BEAD, FERRITE
L43	1-543-184-00	BEAD, FERRITE
L44	1-543-190-00	BEAD, FERRITE
L45	1-543-184-00	BEAD, FERRITE
L46	1-543-190-00	BEAD, FERRITE
L47	1-543-190-00	BEAD, FERRITE
L48	1-543-184-00	BEAD, FERRITE
Q1	8-729-117-54	2SA1175
Q2	8-729-178-54	2SC2785
Q3	8-729-178-54	2SC2785
Q4	8-729-178-54	2SC2785
Q5	8-729-671-14	2SC710
Q7	8-729-178-54	2SC2785
Q8	8-729-811-11	TRANSISTOR 2SD1111
R1	1-246-521-00	CARBON 100K 5% 1/4W
R2	1-246-473-00	CARBON 1K 5% 1/4W
R3	1-246-497-00	CARBON 10K 5% 1/4W
R4	1-246-497-00	CARBON 10K 5% 1/4W
R5	1-246-521-00	CARBON 100K 5% 1/4W
R6	1-246-521-00	CARBON 100K 5% 1/4W
R7	1-246-475-00	CARBON 1.2K 5% 1/4W
R8	1-246-457-00	CARBON 220 5% 1/4W
R9	1-246-433-00	CARBON 22 5% 1/4W
R10	1-246-473-00	CARBON 1K 5% 1/4W
R11	1-246-461-00	CARBON 330 5% 1/4W
R12	1-246-461-00	CARBON 330 5% 1/4W
R13	1-246-459-00	CARBON 270 5% 1/4W
R14	1-246-433-00	CARBON 22 5% 1/4W
R15	1-246-433-00	CARBON 22 5% 1/4W
R16	1-246-433-00	CARBON 22 5% 1/4W
R17	1-246-433-00	CARBON 22 5% 1/4W
R18	1-246-485-00	CARBON 3.3K 5% 1/4W
R19	1-246-485-00	CARBON 3.3K 5% 1/4W
R20	1-246-485-00	CARBON 3.3K 5% 1/4W
R21	1-246-485-00	CARBON 3.3K 5% 1/4W
R24	1-246-485-00	CARBON 3.3K 5% 1/4W
R25	1-246-485-00	CARBON 3.3K 5% 1/4W
R26	1-246-485-00	CARBON 3.3K 5% 1/4W
R27	1-246-485-00	CARBON 3.3K 5% 1/4W
R28	1-246-485-00	CARBON 3.3K 5% 1/4W
R29	1-246-485-00	CARBON 3.3K 5% 1/4W
R30	1-246-521-00	CARBON 100K 5% 1/4W
R31	1-246-537-00	CARBON 470K 5% 1/4W
R32	1-246-489-00	CARBON 4.7K 5% 1/4W

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Ref. No.	Parts No.	Description
R33	1-246-461-00	CARBON 330 5% 1/4W
R34	1-246-461-00	CARBON 330 5% 1/4W
R35	1-246-461-00	CARBON 330 5% 1/4W
R36	1-246-458-00	CARBON 240 5% 1/4W
R37	1-246-450-00	CARBON 110 5% 1/4W
R38	1-246-458-00	CARBON 240 5% 1/4W
R39	1-246-450-00	CARBON 110 5% 1/4W
R40	1-246-458-00	CARBON 240 5% 1/4W
R41	1-246-450-00	CARBON 110 5% 1/4W
R42	1-246-461-00	CARBON 330 5% 1/4W
R43	1-246-462-00	CARBON 360 5% 1/4W
R44	1-246-463-00	CARBON 390 5% 1/4W
R45	1-246-489-00	CARBON 4.7K 5% 1/4W
R46	1-246-466-00	CARBON 510 5% 1/4W
R47	1-246-445-00	CARBON 68 5% 1/4W
R48	1-246-443-00	CARBON 56 5% 1/4W
R49	1-246-467-00	CARBON 560 5% 1/4W
R50	1-246-489-00	CARBON 4.7K 5% 1/4W
R51	1-246-481-00	CARBON 2.2K 5% 1/4W
R52	1-246-459-00	CARBON 270 5% 1/4W
R53	1-246-466-00	CARBON 510 5% 1/4W
R64	1-246-453-00	CARBON 150 5% 1/4W
R65	1-246-485-00	CARBON 3.3K 5% 1/4W
R66	1-246-453-00	CARBON 150 5% 1/4W
R67	1-246-453-00	CARBON 150 5% 1/4W
R68	1-246-449-00	CARBON 100 5% 1/4W
R69	1-246-485-00	CARBON 3.3K 5% 1/4W
R70	1-246-485-00	CARBON 3.3K 5% 1/4W
R71	1-246-496-00	CARBON 9.1K 5% 1/4W
R72	1-246-489-00	CARBON 4.7K 5% 1/4W
R73	1-246-513-00	CARBON 47K 5% 1/4W
R74	1-246-433-00	CARBON 22 5% 1/4W
R75	1-246-433-00	CARBON 22 5% 1/4W
R76	1-246-449-00	CARBON 100 5% 1/4W
R77	1-246-450-00	CARBON 110 5% 1/4W
R78	1-246-414-00	CARBON 3.6 5% 1/4W
R79	1-246-485-00	CARBON 3.3K 5% 1/4W
R80	1-246-485-00	CARBON 3.3K 5% 1/4W
R81	1-246-485-00	CARBON 3.3K 5% 1/4W
R82	1-246-485-00	CARBON 3.3K 5% 1/4W
R83	1-246-451-00	CARBON 120 5% 1/4W

Ref. No.	Parts No.	Description
RB1	1-232-198-00	COMPOSITION CIRCUIT BLOCK
RB2	1-232-198-00	COMPOSITION CIRCUIT BLOCK
RB3	1-232-371-00	COMPOSITION CIRCUIT BLOCK
RB4	1-232-361-00	COMPOSITION CIRCUIT BLOCK (S/N 10101 AND HIGHER)
TH1	1-560-916-00	POST, CONNECTOR 20P
X1	1-527-991-12	VIBRATOR, CRYSTAL

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Ref. No.	Parts No.	Description
IF-30 BOARD		
	A-8051-019-B	COMPLETE PCB, SUB (IF-30)
C201	1-123-330-00	ELECT 22 20% 16V
C202	1-161-025-00	CERAMIC 0.1 12V
C203	1-161-025-00	CERAMIC 0.1 12V
C204	1-161-025-00	CERAMIC 0.1 12V
C205	1-161-025-00	CERAMIC 0.1 12V
C206	1-161-025-00	CERAMIC 0.1 12V
C207	1-123-330-00	ELECT 22 20% 16V
C208	1-161-025-00	CERAMIC 0.1 12V
C209	1-123-330-00	ELECT 22 20% 16V
C210	1-161-025-00	CERAMIC 0.1 12V
C211	1-101-004-21	CERAMIC 0.01 50V
C212	1-161-025-00	CERAMIC 0.1 12V
C213	1-123-356-00	ELECT 10 20% 16V
C214	1-123-330-00	ELECT 22 20% 16V
C215	1-141-260-00	CAP, TRIMMER 50PF
C216	1-101-974-00	CERAMIC 20PF 5% 50V
C217	1-102-115-00	CERAMIC 560PF 10% 50V
C218	1-161-326-00	CERAMIC 2200PF 30% 50V
CN201	1-560-462-00	PIN, CONNECTOR 6P
CN202	1-560-459-00	PIN, CONNECTOR 3P
CN203	1-560-459-00	PIN, CONNECTOR 3P
CN204	1-560-461-00	PIN, CONNECTOR 5P
D201	8-719-815-55	DIODE 1S1555
IC201	8-759-901-39	IC SN74LS139N
IC202	8-759-900-32	IC SN74LS32N
IC203	8-759-903-68	IC 74LS368AN
IC204	8-759-902-45	IC SN74LS245N
IC205	8-759-903-59	IC P8251A
IC206	8-759-901-93	IC SN74LS193N
IC207	8-759-903-93	IC SN74LS393N
IC208	8-759-951-88	IC SN75188N
IC209	8-759-951-89	IC SN75189AN
IC210	8-759-131-10	IC μPC311C
IC211	8-759-900-74	IC SN74LS74AN
IC212	8-759-902-44	IC SN74LS244N
IC213	8-759-900-52	IC MSM58321RS
IC214	8-759-902-73	IC SN74LS273N

Ref. No.	Parts No.	Description
P1	1-933-564-00	HARNESS (MS1)
P2	1-933-565-00	HARNESS (MS2)
Q201	8-729-177-43	TRANSISTOR 2SD774
Q202	8-729-201-52	TRANSISTOR 2SA1015
Q203	8-729-606-32	TRANSISTOR 2SC2603
R201	1-246-485-00	CARBON 3.3K 5% 1/4W
R202	1-246-473-00	CARBON 1K 5% 1/4W
R203	1-246-499-00	CARBON 12K 5% 1/4W
R204	1-246-499-00	CARBON 12K 5% 1/4W
R205	1-246-481-00	CARBON 2.2K 5% 1/4W
R206	1-246-481-00	CARBON 2.2K 5% 1/4W
R207	1-246-545-00	CARBON 1M 5% 1/4W
R208	1-246-473-00	CARBON 1K 5% 1/4W
R209	1-246-425-00	CARBON 10 5% 1/4W
R210	1-246-421-00	CARBON 6.8 5% 1/4W
R211	1-246-489-00	CARBON 4.7K 5% 1/4W
R212	1-246-489-00	CARBON 4.7K 5% 1/4W
R213	1-246-485-00	CARBON 3.3K 5% 1/4W
R214	1-246-497-00	CARBON 10K 5% 1/4W
R215	1-246-497-00	CARBON 10K 5% 1/4W
R216	1-246-489-00	CARBON 4.7K 5% 1/4W
R217	1-246-531-00	CARBON 270K 5% 1/4W
R218	1-246-449-00	CARBON 100 5% 1/4W
R219	1-246-499-00	CARBON 12K 5% 1/4W
RB201	1-235-194-11	RESISTOR BLOCK 4.7K
RL201	1-515-488-00	RELAY
S1	1-554-248-00	SWITCH, DIP
S2	1-554-246-00	SWITCH, PUSH (1 KEY)
X201	1-527-990-00	VIBRATOR, CRYSTAL

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Ref. No.	Parts No.	Description
KY-33 BOARD		
	1-556-466-00	CABLE ASSY
	4-345-701-00	HOLDER, LED
	4-603-290-00	RETAINER, SPEAKER
C1	**1-161-025-00**	**CERAMIC 0.1 12V**
C2	**1-161-025-00**	**CERAMIC 0.1 12V**
C3	**1-527-992-21**	**OSCILLATOR, CERAMIC (EITH CAP)**
CN3	**1-560-922-11**	**PIN, CONNECTOR 7P**
CN2	**1-560-923-11**	**PIN, CONNECTOR 13P**
D1	**8-719-102-34**	**DIODE SG232D**
IC1	**8-759-600-37**	**IC M5L8041A-077P**
IC2	**8-759-901-45**	**IC SN74LS145N**
R1	**1-246-457-00**	**COMPOSITION 220 5% 1/4W**
RB1	**1-231-385-00**	**RESISTOR BLOCK 4.7K**
RB2	**1-231-525-00**	**RESISTOR BLOCK 4.7K**
SW1 - 13, 15 - 43, 45 - 72, 74		
	1-552-622-11	**SWITCH, KEY**
SW14	**1-552-762-00**	**SWITCH, KEYBOARD**
SW44	**1-554-250-00**	**SWITCH, KEY (WITH ROCK)**
SP	**1-503-008-00**	**SPEAKER**
X1	**1-527-992-21**	**OSCILLATOR, CERAMIC (EITH CAP)**

Ref. No.	Parts No.	Description
PK-1 BOARD		
	9-982-369-00	MOUNTED PCB PK-1
C7	**9-982-372-00**	**ELECT 220μF 200V (172049) 105°C**
D1	**8-719-100-52**	**DIODE 5P2M**
F2	**9-982-370-00**	**FUSE MT4239A 115°C**
R1	**9-982-371-00**	**CEMENT 15 3W**
R2	**1-246-473-00**	**CARBON 1K 1/4W**
R3	**1-206-640-00**	**METAL 100 1W**

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3. There is the designated parts in the board layout and schematic diagram. However, for parts with the parts No. not described in the parts list, if the parts is defective, many other parts also may be defective. It is recommended to replace the board (PK-1, PK-2, etc.) itself. Therefore, it is not stored as spare parts.

Ref. No.	Parts No.	Description
PK-2 BOARD		
	9-982-373-00	MOUNTED PCB PK-2
C12	**9-982-375-00**	**ELECT 1 160V**
C13	**9-982-376-00**	**ELECT 2.2 160V**
C14	**1-102-824-00**	**CERAMIC 470PF 50V**
C15	**1-123-307-00**	**ELECT 100 10V**
D5	**8-719-815-55**	**DIODE 1S1555**
D6	**8-719-815-55**	**DIODE 1S1555**
D21	**9-982-274-00**	**DIODE RD62E-B**
D22	**9-982-274-00**	**DIODE RD62E-B**
D23	**8-719-162-07**	**DIODE RD6.2E**
Q2	**8-729-175-22**	**TRANSISTOR 2SC2752**
Q3	**8-729-175-22**	**TRANSISTOR 2SC2752**
R7	**1-246-509-00**	**CARBON 33K 1/4W**
R8	**1-247-123-00**	**CARBON 470 1/4W**
R9	**1-246-505-00**	**CARBON 22K 1/4W**
R10	**1-246-529-00**	**CARBON 220K 1/4W**

Ref. No.	Parts No.	Description
PK-3 BOARD		
	9-982-377-00	MOUNTED PCB PK-3
C10	**1-101-821-00**	**CERAMIC 2200PF 500V**
C11	**1-161-064-00**	**CERAMIC 1000PF 50V**
D3	**9-982-379-01**	**DIODE 11DQ04**
Q1	**9-982-269-00**	**TRANSISTOR 2SC3056**
R4	**1-206-471-00**	**METAL 22 1W**
R5	**1-206-640-00**	**METAL 100 1W**
R6	**1-214-603-00**	**METAL 47K 2W**
T1	**9-982-380-00**	**TRANSFORMER 0-270**

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Ref. No.	Parts No.	Description
PK-4 BOARD		
	9-982-381-00	MOUNTED PCB PK-4
C103	**1-123-333-00**	**ELECT 100 16V**
C202	**1-123-332-00**	**ELECT 47 25V**
C203	**1-123-333-00**	**ELECT 100 16V**
C302	**1-123-322-00**	**ELECT 330 16V**
C303	**1-123-322-00**	**ELECT 330 16V**
D106	**8-719-815-55**	**DIODE 1S1555 (S/N 11901 AND HIGHER)**
D202	**8-719-815-55**	**DIODE 1S1555**
IC1	**8-759-170-12**	**IC μPC78M12H**
R102	**1-246-489-00**	**CARBON 4.7K 1/4W (S/N UP TO 11900)**
	1-244-691-55	**CARBON 5.6K 1/4W (S/N 11901 AND HIGHER)**
R103	**1-246-473-00**	**CARBON 1K 1/4W**
R201	**1-206-666-00**	**METAL 1.2K 2W**
R302	**1-206-666-00**	**METAL 1.2K 2W**
R304	**1-246-501-00**	**CARBON 15K 1/4W (S/N 11901 AND HIGHER)**
R306	**1-244-682-25**	**CARBON 2.4K 1/4W (S/N 11901 AND HIGHER)**

Ref. No.	Parts No.	Description
PK-5 BOARD		
	9-982-382-00	MOUNTED PCB PK-5
C105	**1-123-330-00**	**ELECT 22 25V**
C106	**1-161-076-00**	**CERAMIC 0.1 50V**
C107	**1-123-356-00**	**ELECT 10 25V**
C108	**1-123-356-00**	**ELECT 10 25V**
C109	**1-161-068-00**	**CERAMIC 4700PF 50V**
C110	**1-123-330-00**	**ELECT 22 25V**
C111	**1-161-064-00**	**CERAMIC 1000PF 50V (U: S/N 10101 AND HIGHER)**
C112	**1-161-064-00**	**CERAMIC 1000PF 50V (U: S/N 10101 AND HIGHER)**
D102	**8-719-815-55**	**DIODE 1S1555**
D103	**8-719-815-55**	**DIODE 1S1555**
D104	**8-719-815-55**	**DIODE 1S1555**
D107	**8-719-815-55**	**DIODE 1S1555 (S/N 11901 AND HIGHER)**
IC1	**9-982-383-01**	**IC PCM-1001**
R104	**1-246-455-00**	**CARBON 180 1/4W**
R105	**1-246-497-00**	**CARBON 10K 1/4W**
R106	**1-246-473-00**	**CARBON 1K 1/4W**
R107	**1-246-485-00**	**CARBON 3.3K 1/4W**
R108	**1-246-473-00**	**CARBON 1K 1/4W**
R109	**1-247-097-00**	**CARBON 39 1/4W**
R110	**1-247-171-00**	**CARBON 47K 1/4W**
R111	**1-246-473-00**	**CARBON 1K 1/4W**
R112	**1-247-171-00**	**CARBON 47K 1/4W (S/N 11901 AND HIGHER)**
R305	**1-246-497-00**	**CARBON 10K 1/4W (S/N 11901 AND HIGHER)**
RV101	**9-982-384-00**	**ADJUSTABLE 470**

NOTE:

1. **The shaded and ⚠-marked components are critical to safety.**
   Replace only with same components as specified.

2. Parts printed in **Bold-Face type** are normally stocked for replacement purposes. The remaining parts shown in this manual are not normally required for routine service work. Orders for parts not shown in Bold-Face type will be processed, but allow for additional delivery time.

3. There is the designated parts in the board layout and schematic diagram. However, for parts with the parts No. not described in the parts list, if the parts is defective, many other parts also may be defective. It is recommended to replace the board (PK-1, PK-2, etc.) itself. Therefore, it is not stored as spare parts.

Ref. No.	Parts No.	Description
PK-6 BOARD		
	9-982-385-00	MOUNTED PCB PK-6
C8	**1-161-707-00**	**CERAMIC 150PF 500V**
C9	**9-982-392-00**	**ELECT 4.7 250V**
C101	**9-982-390-00**	**CERAMIC 3300PF 500V**
C102	**1-123-311-00**	**ELECT 1000 10V**
C201	**9-982-391-00**	**CERAMIC 1000PF 500V**
C204	**9-982-391-00**	**CERAMIC 1000PF 500V (U: S/N 10101 AND HIGHER)**
C205	**9-982-391-00**	**CERAMIC 1000PF 500V (S/N 11901 AND HIGHER)**
C301	**9-982-391-00**	**CERAMIC 1000PF 500V**
D4	**9-982-271-00**	**DIODE TVR-06J**
D101	**9-982-389-01**	**DIODE C10P04Q**
D105	**9-982-379-01**	**DIODE 11DQ04**
D201	**8-719-903-02**	**DIODE ESAC33-02C**
D301	**8-719-903-02**	**DIODE ESAC33-02C**
F1	**9-982-387-00**	**FUSE TSCR 3.15A**
R202	**1-213-125-00**	**METAL 33 1/2W (U: S/N 10101 AND HIGHER)**
R203	**1-213-125-00**	**METAL 33 1/2W (U: S/N 11901 AND HIGHER)**
S1	**9-982-386-00**	**SWITCH SDE4S-C #3**

10-3. PACKING MATERIAL AND ACCESSORY

No.	Parts No.	Description
	3-701-625-00	BAG, POLYETHYLENE
	3-701-630-00	BAG, POLYETHYLENE
	3-773-122-22	**MANUAL, INSTRUCTION (for USA, CND)**
	3-773-122-31	**MANUAL, INSTRUCTION (for CND)**
	3-795-472-21	CARD, QUICK REFERENCE
	3-795-473-22	**CARD, QUICK REFERENCE**
	4-603-364-00	INDIVIDUAL CARTON
	4-603-365-00	CUSHION (LEFT), UPPER
	4-603-366-00	CUSHION (RIGHT), UPPER
	4-603-367-00	CUSHION (LEFT), LOWER
	4-603-368-00	CUSHION (RIGHT), LOWER
	4-858-588-00	BAG, POLYETHYLENE (for CND)

10-4. FIXTURE (OPTIONAL)

Ref. No.	Parts No.	Description
	J-6205-290-A	**SA JIG BOARD FOR SMC-70**
	J-6200-200-A	**KEY TOP DRAWING JIG FOR SMC-70**

Measuring equipment on the market:

HEWLETT PACKARD 5004A . . . SIGNATURE ANALYZER
FREQUENCY COUNTER
VOLTMETER

Sony's products

SMW-7002 . . . CP/M OPERATING SYSTEM

NOTE:

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3. There is the designated parts in the board layout and schematic diagram. However, for parts with the parts No. not described in the parts list, if the parts is defective, many other parts also may be defective. It is recommended to replace the board (PK-1, PK-2, etc.) itself. Therefore, it is not stored as spare parts.